ARCHITECTURAL METALS

BY ANACONDA

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THE AMERICAN BRASS COMPANY

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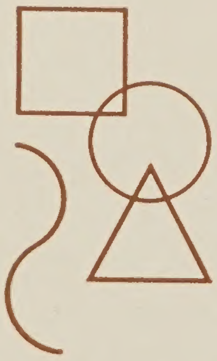

The geometric designs are symbolic of the progressive development in architecture. The rectangle relates to the post-and-beam architecture of ancient Greece; the radius of the circle formed the arch invented by the Romans; the angular form is of early modern; and the compound curve represents the present trend in more imaginative design, and the free hand of the artist and sculptor.

ARCHITECTURAL METALS BY ANACONDA

THE AMERICAN BRASS COMPANY
WATERBURY 20, CONNECTICUT

BRONZE . . . THE ONLY MATERIAL THAT IMPROVES WITH AGE

This Bronze sundial on the south wall of the Bok Singing Tower in Lake Wales, Florida, is notable for its beauty and individuality of design.

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Foreword

The information contained in this book has been compiled for the benefit of architects, engineers, draftsmen, specification writers and for the trades that are concerned with the processing, fabricating and installation of Copper, Brass, Bronze and Nickel Silver in the building arts.

This publication was prepared with the express purpose of providing the architect, the engineer and the fabricator with reliable information that will lead to the intelligent and economical use of these—the worthiest of architectural metals.

If there are errors or omissions in our listings of architects, designers, fabricators or contractors associated with the work illustrated in this book, we ask that the discrepancies be brought to our attention in order that corrections may be made in a subsequent edition.

Acknowledgments

FABRICATORS: A sincere appreciation is extended to the membership of the National Association of Architectural Metal Manufacturers for willing co-operation in the collection of material for this publication.

DETAILERS: The details of construction for the architectural metal work were obtained through the generosity and good will of architects and architectural metal fabricators.

DESIGNERS: This publication was inspired and stimulated by encouragement from the architectural profession, from schools of design, and from decorators, sculptors and manufacturers of builders' hardware.

This book is dedicated to architectural designers, students of design, sculptors and artificers in metals.
—The American Brass Company

INTRODUCTION

Architectural art

A silent but meaningful expression in architecture is effected by linear design, color, texture and finish, and an artistic combination of building elements. By judicious selection of materials and by skillful arrangement, an architect is able to create the appearance of affluence and stability or—at will—a feeling of delicacy and refinement, in each case with attendant architectural beauty.

Classic

As a building of classic design is associated with, and architecturally is a part of, the splendor of ancient Greece or Rome, so are the buildings of contemporary design identified with the character and achievement of this age. They are also particularly expressive of an important change in the concept of architectural art.

Contemporary

The American modification of classic Roman architecture, based on Vignola, was born of the stone age in building. It has therefore been executed mostly in stone or other masonry, and in wood, with an occasional detail in metal. The *new* contemporary architecture belongs to the metal age or, more correctly, the machine age. This architecture, in metal, is perfectly in harmony with all things that are normal to civilized people in this twentieth century. Moreover, it costs less to erect a building of first-class design with this style of architecture than with any other style in history.

Production economies in metals

Volume production of architectural metals by rolling, extruding, shape rolling, or drawing makes it possible to design so that construction is simple and economical. This is more advantageous with modern design, but it also offers an advantage in all types of architecture, regardless of style. For complete archi-

Seagram Building, 375 Park Avenue, New York City.

tectural composition it is still necessary to employ some of the older arts such as casting, forging, stamping, spinning, and at least a token amount of statuary or sculptured ornament.

Color in metals

The architectural designer can obtain greater latitude of design by combining two or more of the architectural metals. A very handsome effect can be obtained by using copper-base alloys such as Bronze or Nickel Silver for the entrance and the architecture near the ground level, and by employing other materials for the body of the building or superstructure. Color accents can be obtained through the use of porcelain enamels, colored glass, and other complementary materials.

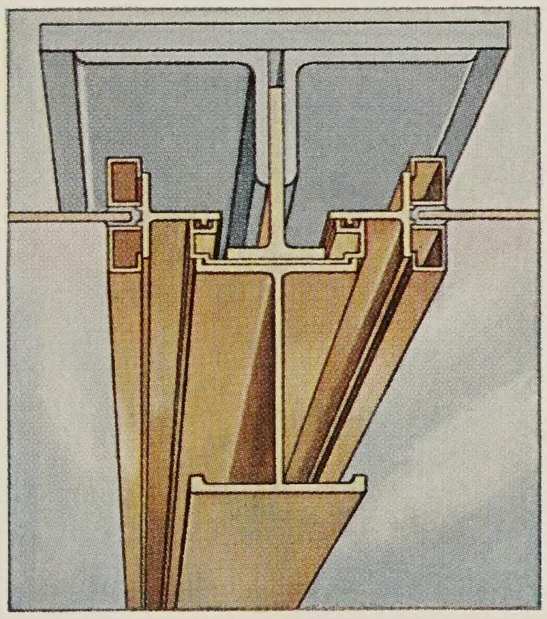
Perpetuation

Even though the architectural use of metals other than the alloys of copper has been relatively recent, an important lesson has been learned from experience and observation. It is this—that *ALL* metals require care if they are to be kept clean and look their best. The oxidized coloring of Copper, Bronze and Nickel Silver, whether acquired naturally or by artificial means, is more artistic and less expensive to maintain than their natural, bright colors. However, the original beautiful luster of the metals can be retained by the application of colorless protective coatings. As the bright metal finish is usually limited to entrances and metalwork at the street level within easy reach, it is neither difficult nor expensive to renew the surface coating from time to time.

Selection of materials

In architecture, the beauty of form and color, and the quality of design transcend all else. The intrinsic worth of the materials that make up a beautiful building meant to serve mankind for many years is of small relative importance; therefore, the use of the best in materials is well justified. Copper, Brass, Bronze, and Nickel Silver rank foremost in suitability.

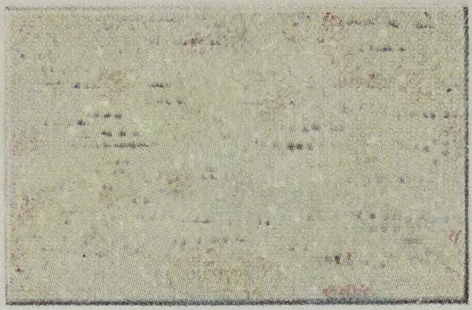
Largest Architectural Bronze extrusion ever made—7½″ diagonal.



This "looking down" view shows the assembly of extruded shapes which compose the architectural mullions on the Seagram Building.

COLOR GUIDE—These colors approximate the actual colors of standard Anaconda Architectural Metals.

COPPER - BRIGHT


COPPER - NATURAL PATINA

COPPER - ARTIFICIAL PATINA

EVERDUR®

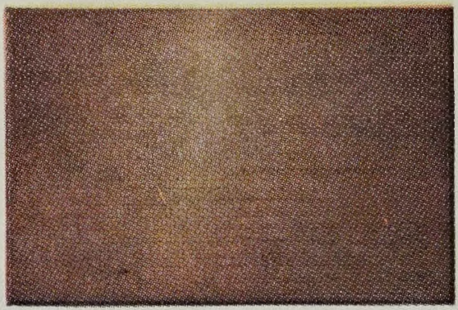
ARCHITECTURAL BRONZE

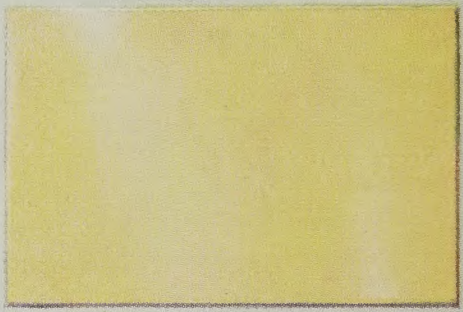
MUNTZ METAL

NICKEL SILVER-13%

COMMERCIAL BRONZE

RED BRASS


STATUARY BRONZE FINISH†


YELLOW BRASS

† Commonly applied to Architectural Bronze, Muntz Metal and Red Brass.

STANDARD ANACONDA ARCHITECTURAL METALS
Composition, Forms Available and Color

Name	Nominal Composition, Per Cent	Sheet	Rod	Tube	Extruded Shapes	Drawn Shapes	Ingot	Color
Copper-100 (Electrolytic Tough Pitch)	99.9+Copper	✓	✓	✓	✓	✓	...	Copper
Everdur-1010	95.8 Copper, 3.1 Silicon, 1.1 Manganese	✓	✓	✓	**✓	✓	...	Reddish Old Gold
Commercial Bronze-14	90 Copper, 10 Zinc	✓	✓	✓	...	✓	...	Bronzy Copper
Red Brass-24	85 Copper, 15 Zinc	✓	✓	*✓	...	✓	...	Reddish Yellow
Yellow Brass (Cartridge Brass-42)	70 Copper, 30 Zinc	✓	✓	✓	...	✓	...	Yellow
Muntz Metal-66	60 Copper, 40 Zinc	*✓	✓	...	...	✓	...	Reddish High Bronze
Architectural Bronze-280	56 Copper, 41.5 Zinc, 2.5 Lead	...	✓	...	*✓	...	...	High Bronze
‡ Statuary Bronze (Suggested Alloy)	82.5 Copper, 12.5 Zinc, 2.5 Tin, 2 Lead, .5 Nickel	...	...	...	...	...	*✓	High Golden Bronze
Leaded Nickel Silver, 10%-825	45 Copper, 42 Zinc, 10 Nickel, 2 Manganese, 1 Lead	...	✓	...	✓	...	...	Creamy Silver
Nickel Silver, 10%-751	65 Copper, 24.75 Zinc, 10 Nickel, .25 Manganese	✓	✓	✓	...	✓	...	Yellowish Silver
Nickel Silver, 13%-821	43.25 Copper, 43.6 Zinc, 13 Nickel, .15 Manganese	...	✓	...	✓	...	...	Warm Silver
Nickel Silver, 15%-741	56.5 Copper, 28.25 Zinc, 15 Nickel, .25 Manganese	✓	✓	✓	...	✓	...	Warm Silver
‡ Nickel Silver (Casting Alloy)	55 Copper, 20 Zinc, 12.50 Nickel, 10.50 Lead, 2 Tin	...	...	...	...	...	✓	Warm Silver

* Metals Most Commonly Used in Architectural Compositions.
** Available in Angles, Channels and Tees.
‡ Not made by The American Brass Company.

chapter 1

COPPER AND COPPER ALLOYS FOR ARCHITECTURE

DESCRIPTION OF THE PRINCIPAL ARCHITECTURAL METALS

Color range

There are five distinct classifications of color for design with Copper and its alloys. The colors range from that of pure Copper to Red Brass, through Architectural Bronze to Yellow Brass, and to the white metal, Nickel Silver. These metals may be used alone, for purity of design, or they may be combined for contrasting colors—particularly the red metal with the white. Red Brass may be supplemented with Architectural Bronze for designs that are essentially of Red Brass. In designs where extruded Architectural Bronze prevails, it is usually accompanied by Muntz Metal, Red Brass and Statuary Bronze. Everdur,® like Copper, is distinctive in color and looks best in monochrome, or set off in sharp contrast.

COPPER

Design value

Copper is an ideal outdoor metal. While other materials become soiled and gray on exposure, Copper weathers to a brown coloring and then takes on a permanently beautiful light-green patina. Copper lends itself quite well to chemical treatment for producing the green patina artificially. The deep brown of antique Copper can be acquired by rubbing with oil. The true copper color can be preserved outdoors by coating the metal with a good quality clear lacquer. Local conditions will determine the life of the lacquer.

Uses

Exterior architecture with Copper usually consists of stamped friezes, spandrels, roofs, copings, stiles, rails and band courses.

Workability

Artistic designs in sheet metal can be produced by stamping, spinning, and by the repoussé method of working the metal from the reverse side. Hand forgings of bar stock and railings of Copper tube with wrought fittings have broad architectural possibilities. Casting and extruding are possible in many instances.

RED BRASS

A new architectural metal

Red Brass is also an excellent outdoor metal and has found a place of its own in modern architecture. It has a beautiful color, which weathers to an elegant "statuary bronze" shade. Red Brass has become popular for window walls and for architectural construction in which it is used as a facing material in tubular or bent metal form and is placed over structural framing, such as mullions and door bucks.

Forms available

The architect has several standard forms of mill products of Red Brass available for design, such as sheets, rods, tubes, angles and channels, but no extrusions. In this alloy, sheet metal and tubes are the most useful. An endless variety of shapes can be obtained by the shape-drawing, brake-forming and shape-rolling processes. The designer should bear in mind that all bends that are made in the metal by these methods have a radius. The outside radius may be equal to the thickness of the metal, and the inside radius to half the thickness, but in general the corners are reasonably sharp. Red Brass has always been used in the form of round and rectangular tubes, finished bright, for color match with extruded Architectural Bronze.

BRONZE

The "top brass" in architectural metals

In architectural nomenclature the word "Bronze" generally refers to extruded Architectural Bronze, or assemblies comprised of this and its companion materials Muntz Metal, Red Brass and Statuary Bronze. In an architectural assembly, the color of the Architectural Bronze governs because of the limited color range of the extruded metals. Other associated metals are selected for color match. An ideal choice of materials for a design in Bronze is extruded Architectural Bronze for moldings and for rods and bars; Muntz Metal for flat surfaces, panels and spandrels, and for screws or other fastenings; and Red Brass for tubes and possibly drawn shapes or bars. The Seagram Building in New York is an outstanding example of modern structural art with Architectural Bronze. Cast ornament, either integral or free-standing, is made of an alloy called Statuary Bronze, which resembles Architectural Bronze in color.

Color supremacy

The rich appearance and the warmth of Bronze is unequaled, whether it is finished in the bright metal or toned naturally or by artificial means to the hue of statuary bronze finish. Probably the most serviceable finish is the brownish ebony which can be produced by staining or is attained in time by rubbing with oil or wax.

MUNTZ METAL

The golden twin

Muntz Metal is a natural component of "architecture-in-bronze." It has a number of favorable qualities, the most important being its color, which is approximately that of extruded Architectural Bronze. Other features are its relatively lower cost and the fact that it lends itself well to heavier gage sheet or plate, as used for panels and spandrels.

YELLOW BRASS

The indoor metal

Brasses containing 25% to 38% zinc have a pronounced yellow color. The 70-30 alloy is preferred for interior architectural work because it has a more lively and radiant appearance than other metals, particularly under artificial lighting. Through the years Yellow Brass has been used extensively for lighting fixtures and for finish hardware, and for ecclesiastical furnishings such as candlesticks, sconces and altar rails. Yellow Brass is seldom finished in any but its natural color, and since this metal is used almost exclusively indoors, the brightness of the new metal can be easily maintained with a colorless coating such as lacquer.

NICKEL SILVER

A warm white metal

In appearance, Nickel Silver is a flattering imitation of real silver. It is available to the architect in all forms, including extrusions. Nickel Silver is particularly suitable for composite designs in combination with other copper alloys because of the color harmonies among these kindred metals. In Nickel Silver there are two color tints available for architecture—the creamy silver-white of 10% Nickel Silver extrusions and the more silvery white of the 13% extrusions. The 13% extrusions make the more pleasing effect and should be combined with sheets, rods and tubes of 15% Nickel Silver for a good color match. These materials weather slowly and are often maintained in the natural color of the new metal.

Superior appearance

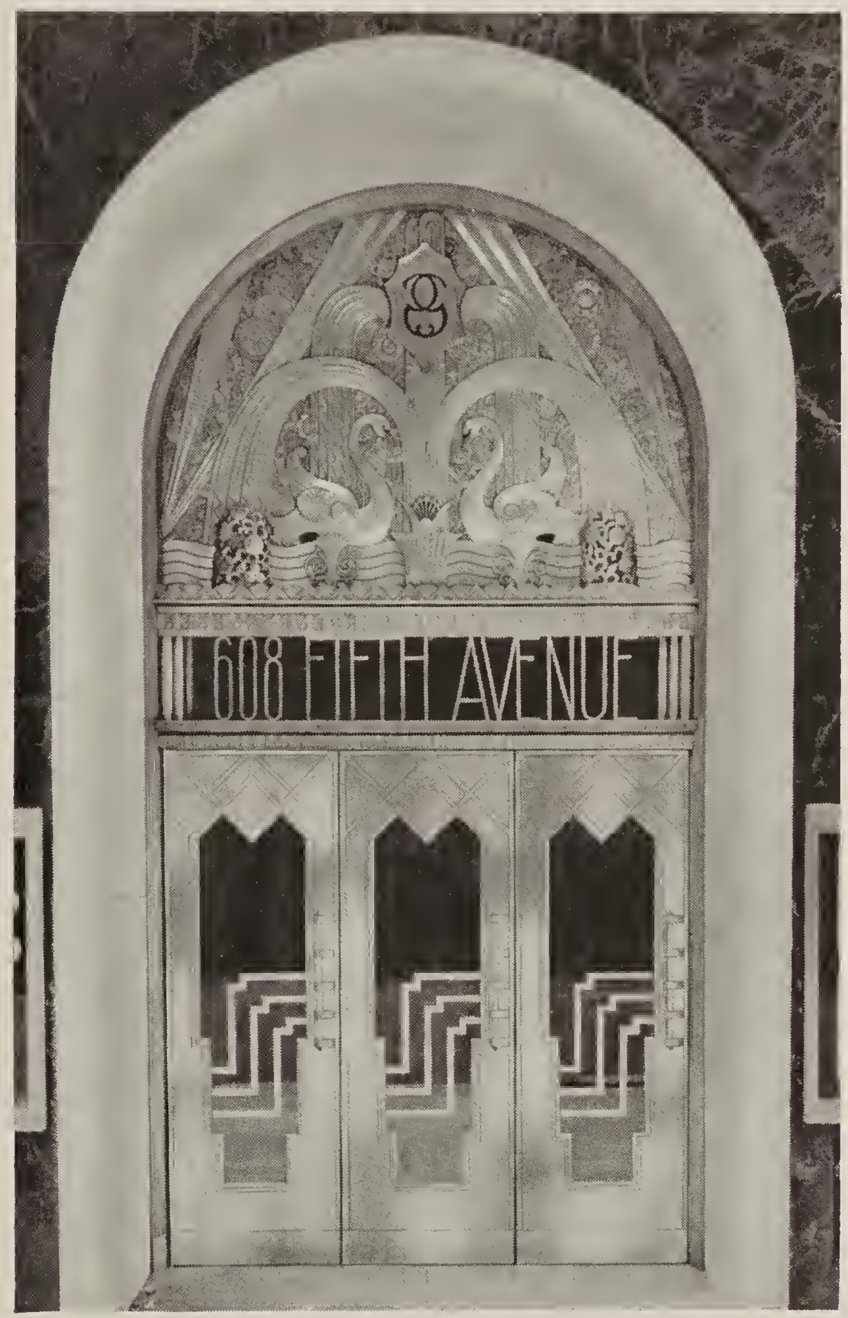
Of all the white metals, Nickel Silver is the richest and is often used at the ground-floor level in designs with other white metals. This preference for Nickel Silver in prominent locations is largely due to its warmth of color and fineness of finish; the excellent architectural quality of its extrusions; and its hard surface, which is not easily scratched or damaged.

EVERDUR®

Distinctive color

High-strength, corrosion-resistant alloys, composed

Everdur Fireplace Hood: Everdur is regarded by many as the most beautiful of the Architectural Metals. In a hood such as this, with straight, flat surfaces, waviness and buckling must be avoided. That was accomplished in this case by using Everdur ⅛-inch thick. Residence of W. M. Bollenbach, Jr.—Minneapolis, Minn.



Nickel Silver is the predominating metal in this entrance, with Copper, Brass and Bronze used to accent the Nickel Silver swans. The entrance is as beautiful today as when installed about 25 years ago. Goelet Building, New York City. E. F. Faile, Architect.

principally of copper and relatively small amounts of silicon and other elements, are made and sold by The American Brass Company under its trade-mark "Everdur."

Everdur is generally regarded as an engineering material by virtue of its toughness and strength, but is considered here because it is one of the most attractive of all metals. Everdur is chosen when it is intended to maintain the true color of the metal, thereby getting the full benefit of its natural beauty. For an antique effect it has no apparent advantage because it weathers to the ultimate deep brown with greenish tones, very much like other alloys of copper.

Forms available

Everdur is available in sheets, tubes, rods and bars; also extruded angles, channels and tees having a ¼″ minimum thickness. The sheet material, when shaped with the proper forming equipment, is more useful in modern architecture. Other desirable characteristics of Everdur are its greater resistance to damage, its excellent welding qualities and its amenability to casting.

COMMERCIAL BRONZE

For a rich red-metal effect

This copper-rich alloy was used quite extensively in the past when many store fronts and entrances were done in sheet metal alone. At that time metal-covered woodwork was in vogue and was produced by drawing the sheet metal tightly over wood. Sheet copper was commonly used to cover fire doors and for other utilitarian purposes. Where architectural appearance was more important, Commercial Bronze with its attractive bronzy copper color was preferred.

Available in standard forms

Although this alloy cannot be extruded, the many forms in which it is available make it possible to achieve good architectural design entirely of Commercial Bronze. It is produced in sheets, rods, bars, tubes and in drawn or rolled shapes from flat metal, as well as in hollow shapes made from tubes. It can also be used for contrast with other metals, but not for color match with extruded Architectural Bronze. For such use it has been supplanted by Red Brass.

chapter 2

THE WORKING OF COPPER AND ITS ALLOYS FOR ARCHITECTURAL USE

Replica of "Mercury", by Giovanni da Bologna, cast in Bronze by Flour City Ornamental Iron Company, Minneapolis, Minnesota.

CASTING

Art beyond the ability of the machine

Casting is a product of the nobler arts and is more or less essential in good architectural design. The interest in the art of casting varies from time to time and depends on the trend in architecture. Whether or not the statuary or sculptured art is integral with wrought metal from the mill in an architectural composition, it is very important that the colors be alike. This cannot be overemphasized, because it is often possible for an off-color casting to disturb the harmony. Cast Statuary Bronze provides an excellent color match in architectural assemblies with extruded Architectural Bronze and Muntz Metal.

FORGING

The work of the master craftsman

Excellent forgings can be made with Copper and many of its alloys because of their malleability when hot. The outstanding advantage of these metals is that the fine workmanship and detail that is possible will remain over the ages unimpaired by exposure to the weather.

For best results in hand forging of Copper alloys, the metal should be heated to a deep cherry-red in a suitable preheating furnace or in a charcoal fire. The metal should not be put directly in the fire of an ordinary coal-burning forge because of its tendency to pick up sulfur, causing brittleness and difficulty in forging. Another precaution is to keep the work clean and free of contamination from other metals which might disfigure the finished art.

Stamped Copper Cresting shows no sign of deterioration after fifty years. Home Life Building, New York, N. Y.

STAMPING

To imitate solid metal

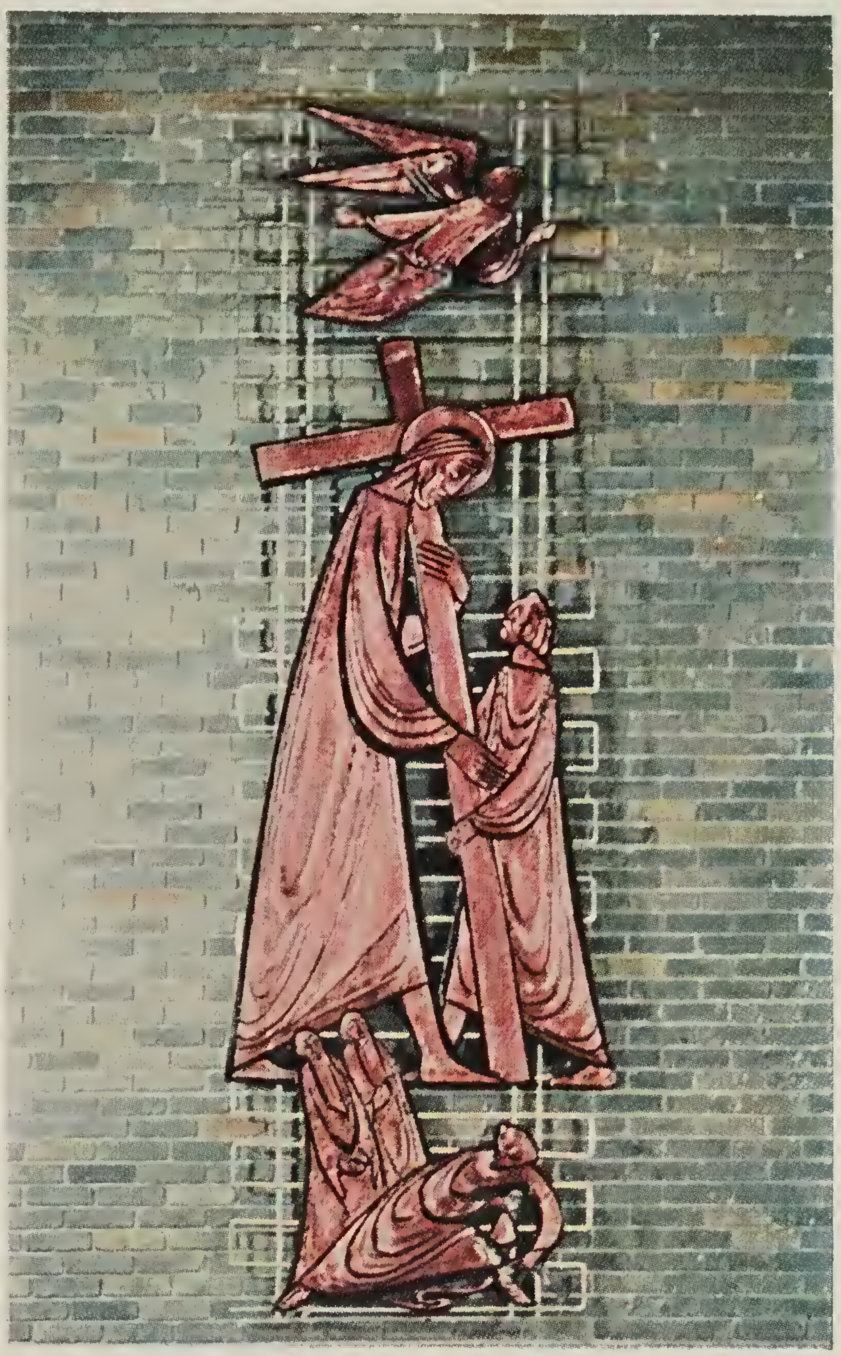
In the working of sheet metal for architectural uses, stamping offers the greatest help to the architect, although spinning and the art of repoussé also contribute something. Stampings can be made in Copper and many of the wrought copper alloys. Those most commonly stamped are Copper, Yellow Brass and Nickel Silver.

Selection of metals

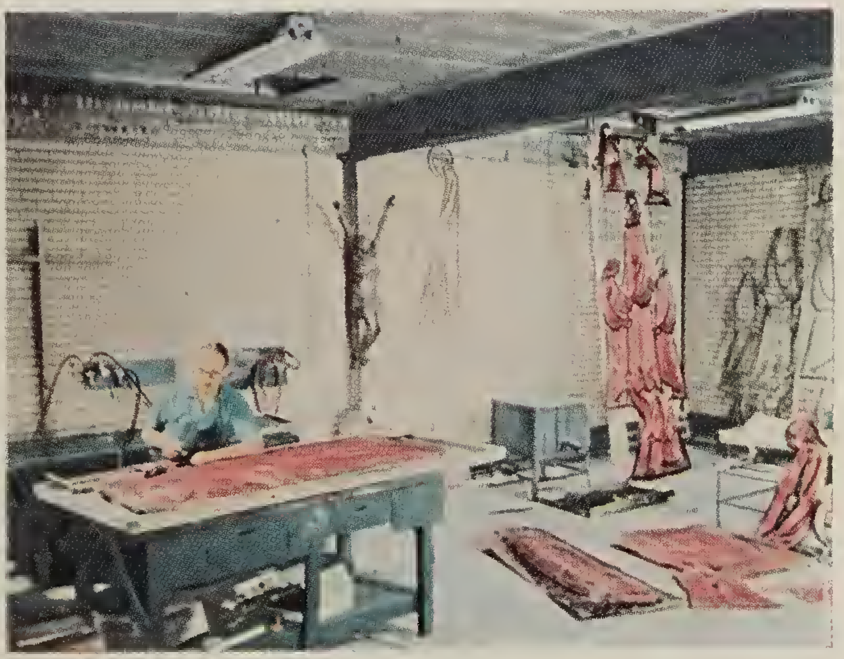
Copper is the outdoor metal and is preferred because it colors so beautifully on exposure to the weather. Yellow Brass, on the other hand, is an indoor metal and looks exceedingly attractive in the bright, new color. Consequently, it is used to a great extent in the stamping of medallions and cartouches, etc., for interior decoration.

Fabricating suggestions

For architectural stampings, best results have been obtained by using commercial "cold-rolled-and-annealed Copper." In general, 20-ounce Copper (.0270″ gage) is the most suitable, although good work has also been done with 16-ounce Copper (.0216″ gage). Practical matters such as depth of draw and ease of forming come into play. The size limitation is around three feet square for the standard lead-and-antimony or Kirksite die. Large designs would require joining smaller pieces together or making a steel die for a heavy press.



One of the fourteen repoussé Sheet Copper "Stations in the Way of the Cross" that complement the starkly modern interior of the Church of St. Gall, Chicago, Illinois. These lightweight pieces of statuary, embossed to a depth of about three inches, are finished to a Statuary Bronze color and then highlighted.



Workshop of the Greco Manufacturing Company, Chicago, where the designing and repoussé work were done. Twenty-ounce, cold-rolled, annealed Sheet Copper was modeled to sectional design forms in a bed of pitch. The several sections were then assembled and mounted on a decorative framework of Brass Rod.

FORMED MILL PRODUCTS

EXTRUDED SHAPES

The most useful machine-formed architectural product

The extrusion of metals is not an ancient art, as it was developed in the twentieth century. By this method brass mills can produce a wide variety of architectural shapes. The process consists of heating cylindrical billets to a semiplastic state and forcing the metal from a closed cylinder through a die. The billet is extruded at a red heat onto a level bench where it is cut to convenient lengths. The shapes extruded in this manner are then straightened by being drawn, cold, through a forming die. Stretch straightening by machine or hand straightening on a workbench also are employed in some cases.

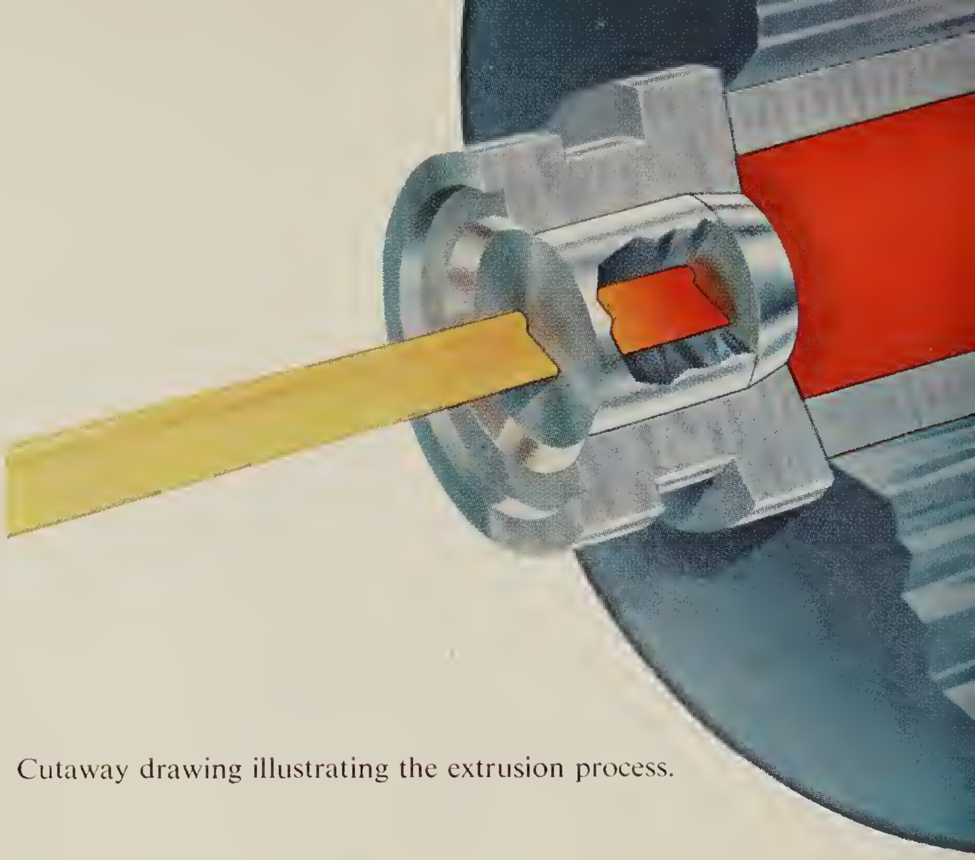
Practical suggestions for design

To select economical shapes that are reasonably easy to manufacture, a few simple rules should be observed.

The greatest diagonal dimension in the cross section of an extruded piece should generally not exceed 6″, although certain balanced sections can be extruded in sizes up to 7½″. A good thickness for average-size Architectural Bronze Extrusions is ⅛″, the economical range being about .093″ to .156″.

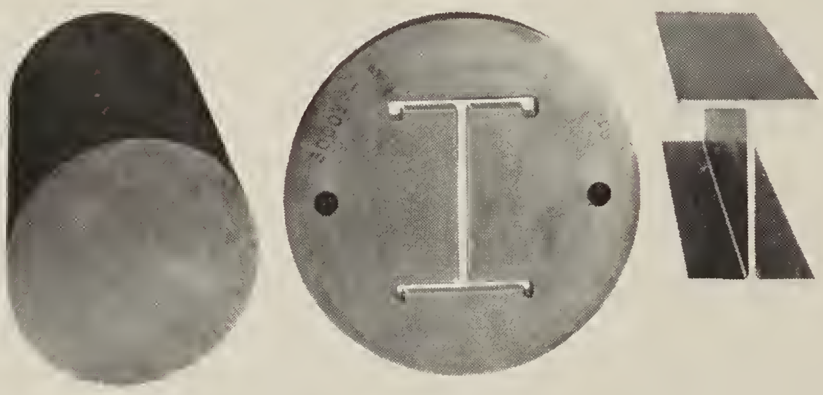
Trough or channel sections are quite common in extruded shapes and, in general, the depth of the channel should not be greater than its width. A section that is of uniform thickness will extrude best. If a section is to have webs and flanges of different thicknesses, the ratio of thick to thin should not exceed 2 to 1. A shape having a thin, wide flange should be designed with a bend or enlargement at the edge to assure uniform flow of the metal during extrusion.

An important advantage lies in balanced sections that allow the hot metal extrusions to slide onto the bench without losing their shape, so that they will not require a great deal of straightening. Solid rods and bars are also common extruded architectural forms. Extrusions of Architectural Bronze are generally intended for architectural use. However, there

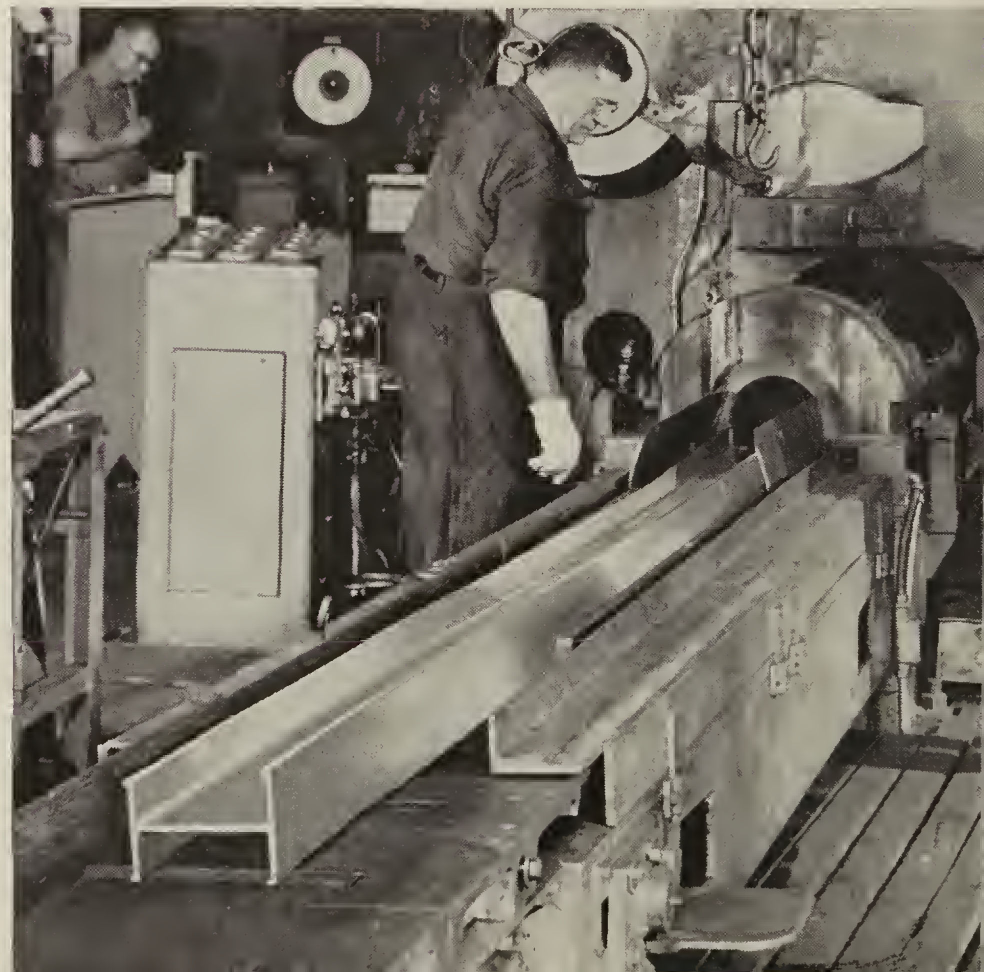


Cutaway drawing illustrating the extrusion process.

Cast billet of Architectural Bronze, at left, is forced through steel die, center, and I-shaped extrusion emerges, right. See photo below.



Extruding large I-Beam section of Architectural Bronze.



are places where they serve both architecture and engineering. Extruded angles and channels of Architectural Bronze are available for certain functional purposes.

DRAWN OR ROLLED SHAPES

Forms available

Architectural shapes of many kinds are also available through the shape-drawing and shape-rolling processes. These shapes are generally made from strip metal and from tubes, although standard or special-shape rods are also used in architecture.

How it is done

For shape rolling, only strip metal is practicable. This process consists of passing the strips of metal through a machine that is equipped with several sets of rolls in tandem, the faces of the rolls being shaped in a manner that will cause the metal to take on, progressively, the desired shape as it goes through the machine. There are some shapes, particularly those that are tubular, that do not lend themselves to this process. In the manufacture of such shapes, the draw bench is brought into use to draw the metal in strip, tube or rod form through a die.

Size limits

Mill limitations and economy in manufacture naturally influence the designs in which architectural metal shapes are to be used. Whether a shape is drawn or rolled, the width of the strip that is put into the machine generally should not be greater than 12″. If made of a tube, it should not exceed 4″ in diameter. The greatest dimension in any direction in the sectional view should be not more than 6″.

Suggested gages

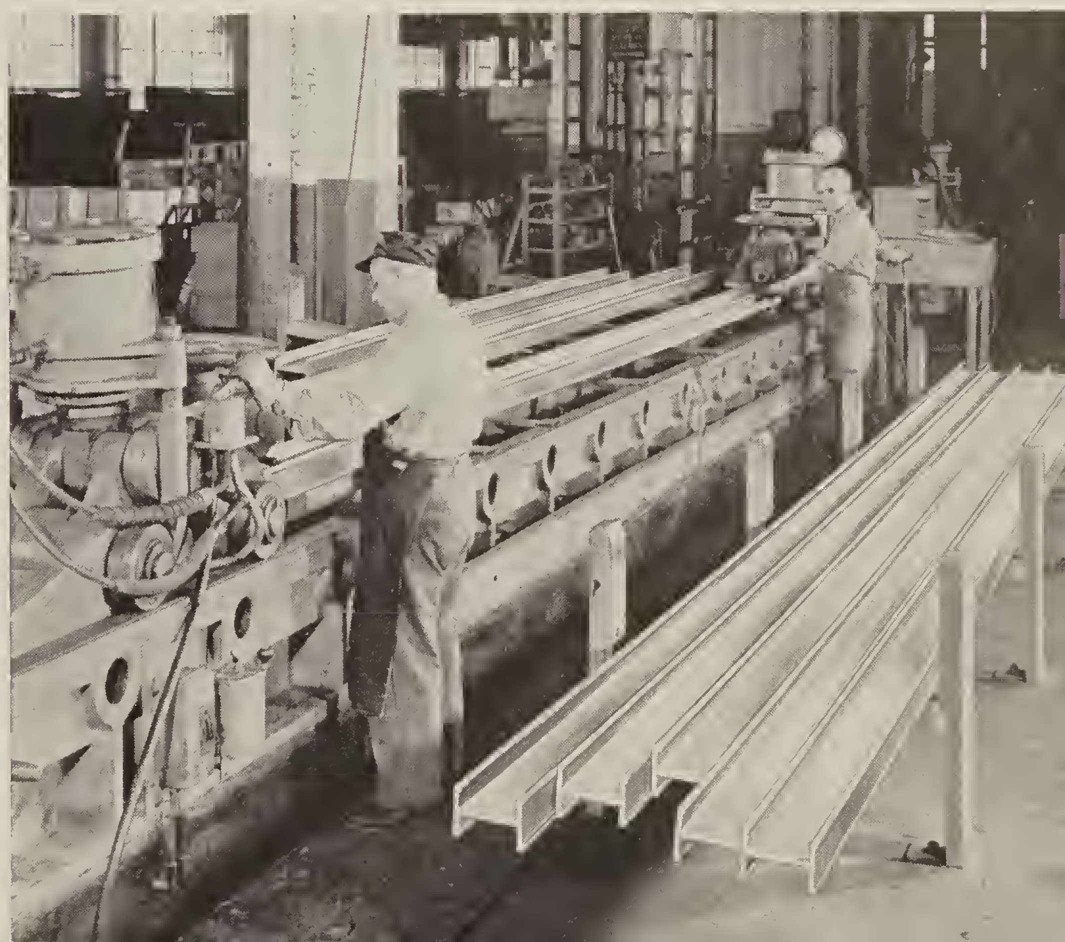
The gage or thickness of the metal, if made of Brass or Bronze, may vary from .025″ to .125″. This represents a wide range and, without some sort of guide, could be confusing. The following may be helpful in determining the gage to be used: For small pieces, with angles that make for rigidity, .025″ gage may suffice. For shapes with a cross section as large as a 3″ circle, if reasonably stiff, .040″ gage should do. Sections that are relatively flat, and range from 4″ to 6″ in the long dimension, should have a minimum metal thickness of .064″.

Convenient lengths

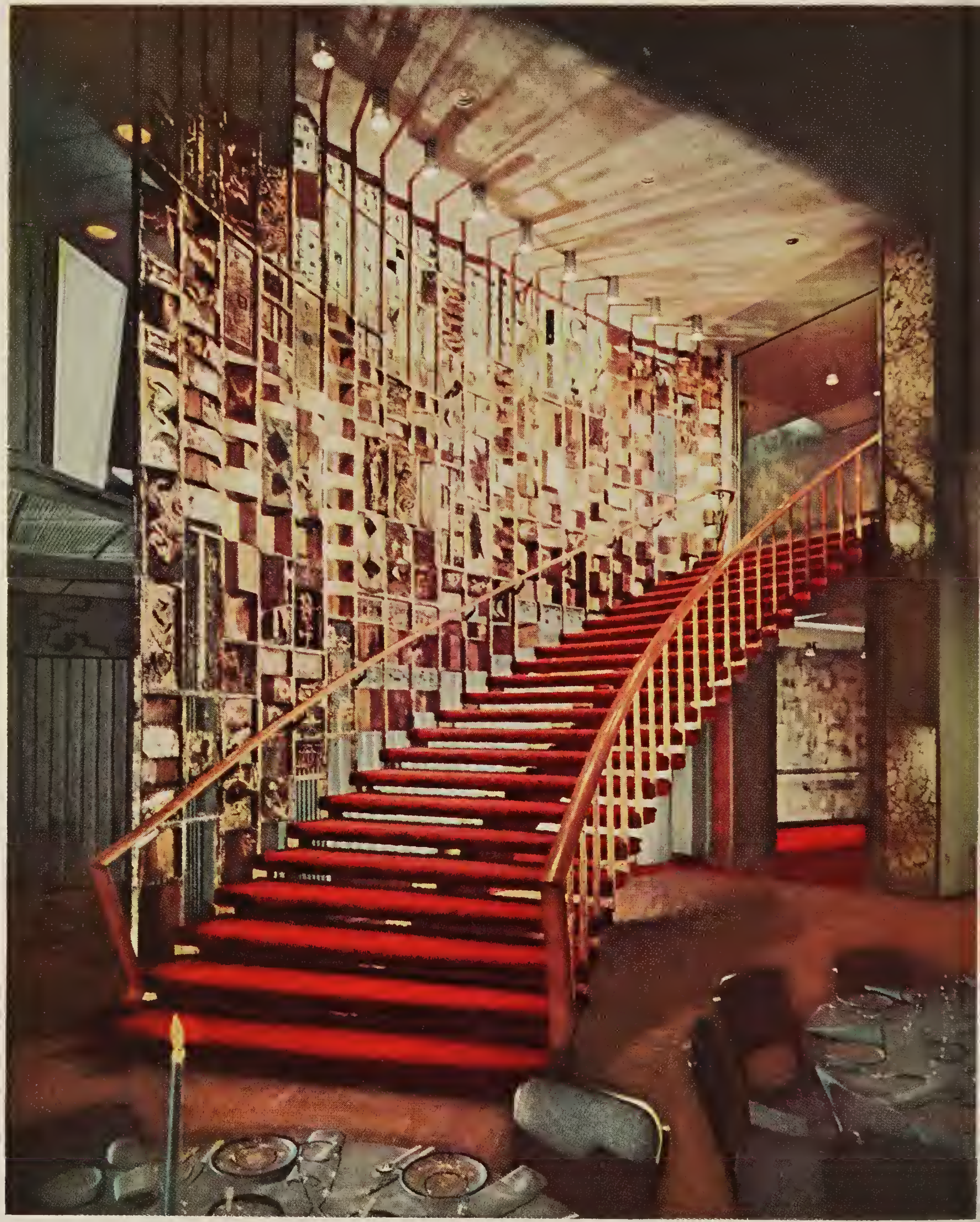
Drawn shapes are available in lengths up to 20 feet, but due to greater difficulty in straightening long lengths, the most satisfactory results are obtained with lengths of 12 feet or 14 feet. Rolled shapes are automatically straightened as they are rolled and, for that reason, lengths of 20 feet are more or less standard, with shorter pieces obtainable on special order.

I-Beam section of Architectural Bronze being drawn through a forming die.

Stretch straightening an I-Beam section of Architectural Bronze.



This open stairway in the Sheraton Hotel, Philadelphia, Pennsylvania, is a good example of modern decoration in the radiant colors of Copper Alloys. Perry, Shaw, Hepburn & Dean, Architects, Boston, Massachusetts. John Rhoden, Sculptor, New York, N. Y.



chapter 3

DESIGN COMPONENTS

GENERAL

Composition

The foregoing chapters describe the various kinds of Copper, Brass and Bronze materials that are available for architectural composition. The utilization of these materials falls entirely within the realm of design, but the manner of joining them, and the use of skills in the fabricating art, including coloring and finishing of metals, are generally influenced by existing means and current techniques.

Apportioning of metals

Work of this kind may be divided into several classes, depending on the character of design and whether the building is to be ornamented heavily, moderately, or lightly. Of course, copper or bronze work is always proper for even the plainest of buildings. In addition, there are other considerations, such as whether the metal is purely ornamental, both decorative and functional, decorative-engineering, or for roofing and flashing.

Judicious employment of the arts

For purely ornamental design, the architect or artist may avail himself of all possible effects through the following arts: Casting, forging, stamping and assembly of brass mill products, such as sheets, rods, tubes and extruded and drawn shapes. In addition, there are the effects that are obtained by sand blasting, etching, striping and coloring with porcelain enamel, and by the inlaying of contrasting metals. The beauty of design may also be enhanced by artistic color toning and surface finishing of the metals.

Combination of metals

Architectural compositions of Bronze usually serve the dual purpose of being functional and ornamental, as in a building entrance, a stairway, an elevator enclosure, an escalator housing or a store front. Work of this kind generally involves a small amount of cast ornament used as enrichment for panels and to relieve molded portions, including easements or ends of stair rails, etc. As a rule, the bulk of the metal in architectural assemblies consists of standard mill products such as Muntz Metal sheets, rods, and bars, Red Brass tubes, and moldings of extruded Architectural Bronze.

Roofing

Work of lesser design significance, such as roofing, valleys, gutters and flashing, as well as skylights, cornices and ventilators, makes use of sheet copper almost exclusively. However, extruded Bronze skylight bars and frame members are used in the construction of skylights.

DESIGN CONSIDERATIONS

Basic advantages

Architectural metals are chosen primarily for their design value, which lies in color, workability and strength, plus enduring service, over-all economy and reasonable maintenance cost. The alloys of Copper rank first in the attractive color of the new metals, as well as in their ultimate color. In workability these metals are quite superior. Ordinarily, architectural metalwork is not designed for structural strength, especially with the modern technique of applying relatively thin facings of architectural metal over a backing of steel sheet, tubes or structural shapes. However, exterior curtain walls in sections one story high can be safely and economically built of Bronze and other alloys of Copper. In addition, these metals have a surface hard enough to withstand ordinary handling and to take a good finish.

Standard-shape mill products

The designer, detailer and fabricator can gain economic advantages through the use of standard sections such as extruded angles, channels and bars, and drawn or rolled shapes of many designs and sizes. Angles, channels, tees, Z-bars, nosings and thresholds, as well as handrails, window and door frame sections are available in extruded Architectural Bronze. Structural Shapes in the form of angles, channels, I-shapes and T-bars are available in extruded Everdur (silicon bronze). Standard open shapes or drawn tubular shapes of wrought metal are available in Red Brass and Yellow Brass. These same shapes in other alloys such as Everdur, Commercial Bronze and Nickel Silver can be obtained on order. See Chapter 5.

To guard against buckling

A factor that needs special consideration in architectural appearance is the buckling of metals. It must be realized that metals reflect light because of their relatively smooth surface; also, that it is difficult to install the material with an entirely flat surface. Buckling becomes more critical the thinner the gage and, of course, is more noticeable with a polished, mirrorlike reflective surface. In view of all this, the architect should specify a metal of sufficiently heavy gage or a backing that will assure sufficient stiffness and support to reduce buckling to a minimum. A dull satin finish will also help.

Gage of metal

There is no simple rule for determining the gage of unsupported sheet metal to prevent noticeable buckling, since face dimensions, loading, expansion and contraction, and framing are all involved. As a guide it may be helpful to know that, for the average stamped ornament, 20-ounce Copper is quite suitable; for metal that is bonded to a rigid material with an adhesive, .032″ to .050″ gage may be considered; and for metal that is loosely fitted to structural steel and to sheet steel backing, .050″ to .093″ gage should be satisfactory. All sheet materials that are to be maintained by lacquering, cleaning, etc., must be backed-up solidly to withstand the pressure that will be applied while performing such operations. Otherwise, the metal may become dished or buckled.

Smart detailing

The matter of originality of design and smart detailing is of first importance. To detail the parts so that the mechanics of the assembly are somewhat mysterious and all joints and fastenings are concealed has become almost a fetish in architectural design with metals.

Strength values

Copper and its alloys are primarily architectural in character, but they can also serve the engineering function of supporting their own weight plus snow and wind loads when used as frames for skylights and windows or for curtain walls. The designer will need to know the tensile strength, yield strength, modulus of elasticity and other physical characteristics of the metals that may be used for such purposes. These data are given below.

AVERAGE VALUES OF PHYSICAL AND MECHANICAL PROPERTIES

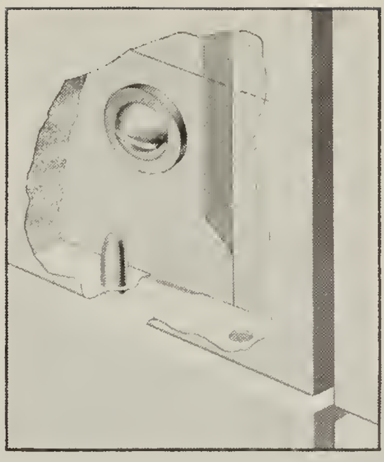
	Tensile Strength, psi	Yield Strength,* psi	Young's Modulus of Elasticity, 10^6 psi	Average Coeff. of Linear Thermal Expansion Per °F (68°-212°F) 10^{-6}	Melting Point (Liquidus) °F	Density, lb. per cubic in.
ELECTROLYTIC TOUGH PITCH COPPER-100						
Cornice Temper Sheet	36,000	28,000	17	9.4	1981	.322
Half Hard Sheet	42,000	36,000	17	9.4	1981	.322
EVERDUR-1010 · Extruded	58,000	22,000	15	9.6	1866	.308
EVERDUR-1010 · Half Hard Sheet	78,000	45,000	15	9.6	1866	.308
COMMERCIAL BRONZE–14 · Half Hard Sheet	52,000	45,000	17	9.7	1913	.318
RED BRASS–24 · Half Hard Sheet	57,000	49,000	17	10.0	1877	.316
RED BRASS–24 · Hard Drawn Tube	65,000	53,000	17	10.0	1877	.316
MUNTZ METAL–66 · Half Hard Sheet	70,000	50,000	15	11.1	1661	.303
ARCHITECTURAL BRONZE-280 · Extruded	60,000	20,000	14	11.1	1623	.305
YELLOW BRASS–42 · Half Hard Sheet	62,000	52,000	15	10.8	1706	.306
NICKEL SILVER, 13%–821 · Extruded	60,000	20,000	16	11.0	1715	.301
LEADED NICKEL SILVER, 10%–825 · Extruded	60,000	20,000	16	11.0	1701	.303
NICKEL SILVER, 15%–741 · Half Hard Sheet	85,000	65,000	18	8.7	1886	.312
NICKEL SILVER, 10%–751 · Half Hard Sheet	72,000	60,000	17	8.7	1868	.313

*At 0.5% extension under load

CURTAIN WALLS

Types

Metal wall facings can be made of economical thicknesses of sheet metal, of ribbed or brake-formed sheet, or of drawn or extruded shapes. Sheet metal is usually formed into wall panels, ribbed or fine-corrugated sheet is applied as outside sheathing, and brake-formed sheet is used as an architectural facing over structural framing. Tubular and irregular shapes made by shape drawing or extruding are used with the functional or with the grid type of design. The metals most suited to these uses are Copper, Everdur, Red Brass, Architectural Bronze, Muntz Metal and Nickel Silver.



Detail at junction of four panels.

General Electric Company's New York World's Fair Building with Copper Panel Facing. Architect: Voorhees, Walker, Smith & Smith, New York, New York.

STAMPED OR FORMED WALL PANELS

Self-weathering joints

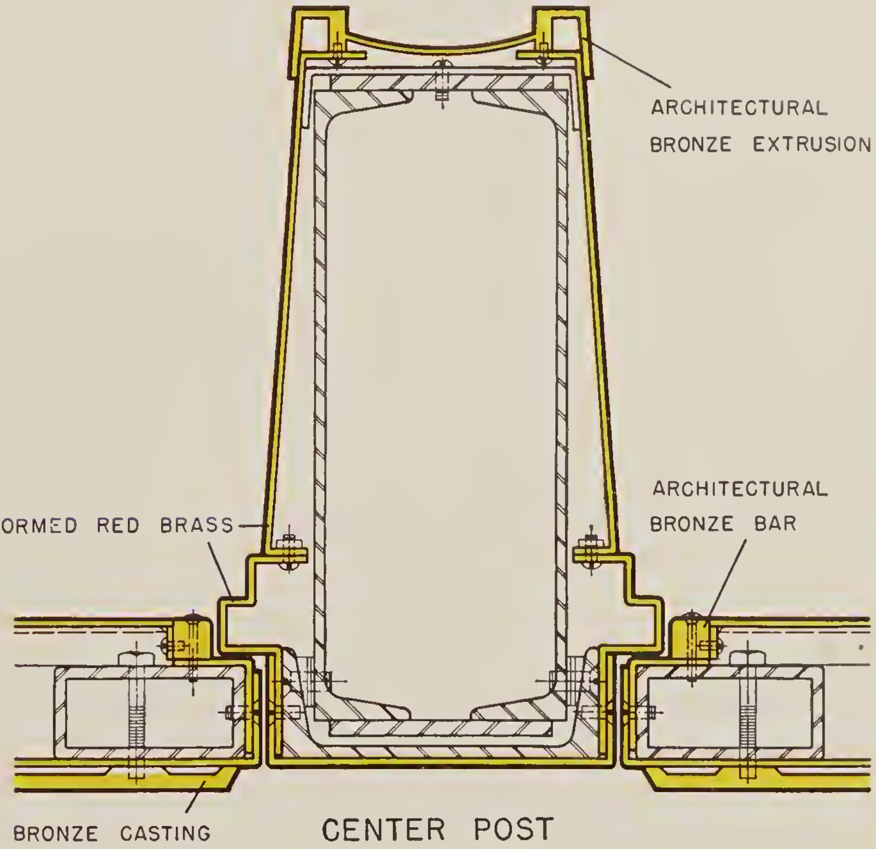
The exterior of the General Electric Company's New York World's Fair Building was entirely of Copper. The facing consisted of 24-ounce gage, cross-crimped, stamped copper panels 24″ wide, 15″ high and 9/16″ deep. A labyrinth type of joint was used, appearing only as a shadow line. The flush panels were installed with a 1/16″ clearance to eliminate the possibility of buckling. The construction was inherently weathertight, requiring no mortar, caulking or other jointing material. The panels were backed with a ½″ thickness of fiberboard for sound deadening and insulation, and to stiffen the panels for safe handling. Most of the Copper was finished in its natural color and protected with a colorless coating of Glyptal lacquer. For contrast and design, certain areas of the Copper facing were treated with an ammonium sulfate solution to obtain an artificial patina.

BRAKE-FORMED AND TUBULAR SHAPES

"Wrap-around" metal facing

These are usually made of heavy-gage metal and are adaptable to the popular grid type of curtain-wall construction, with horizontal face metal and vertical mullions or battens. By using well-designed metal sub-frames and backing, and concealed joining, the finished work can be made very attractive. Red Brass, Copper and Nickel Silver are the preferred materials. Red Brass is favored where a statuary

Representative detail of "wrap-around" construction.

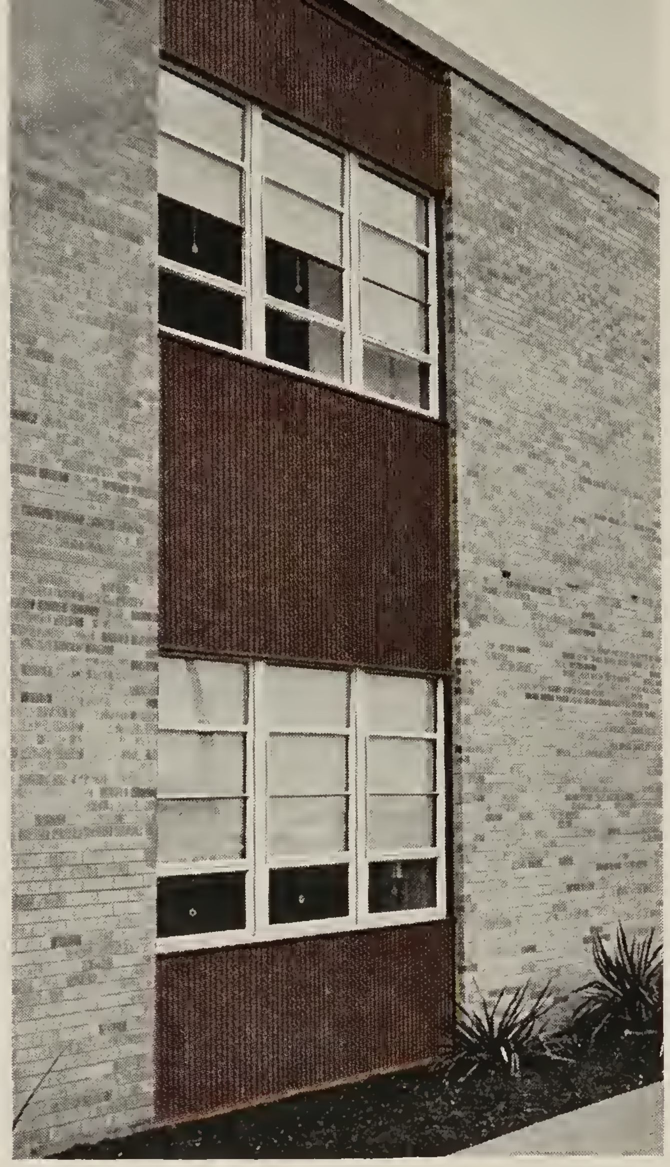


bronze finish or the greenish-gray bronze patina is desired. Copper is the choice for work with an ultimate full-green patina. Nickel Silver is chosen for a warm, white-metal effect with a pearly luster. The gage of metal should range from .064″ (No. 14 B&S) to .125″ and it should be of half-hard temper.

RIBBED OR FINE CORRUGATED SHEATHING

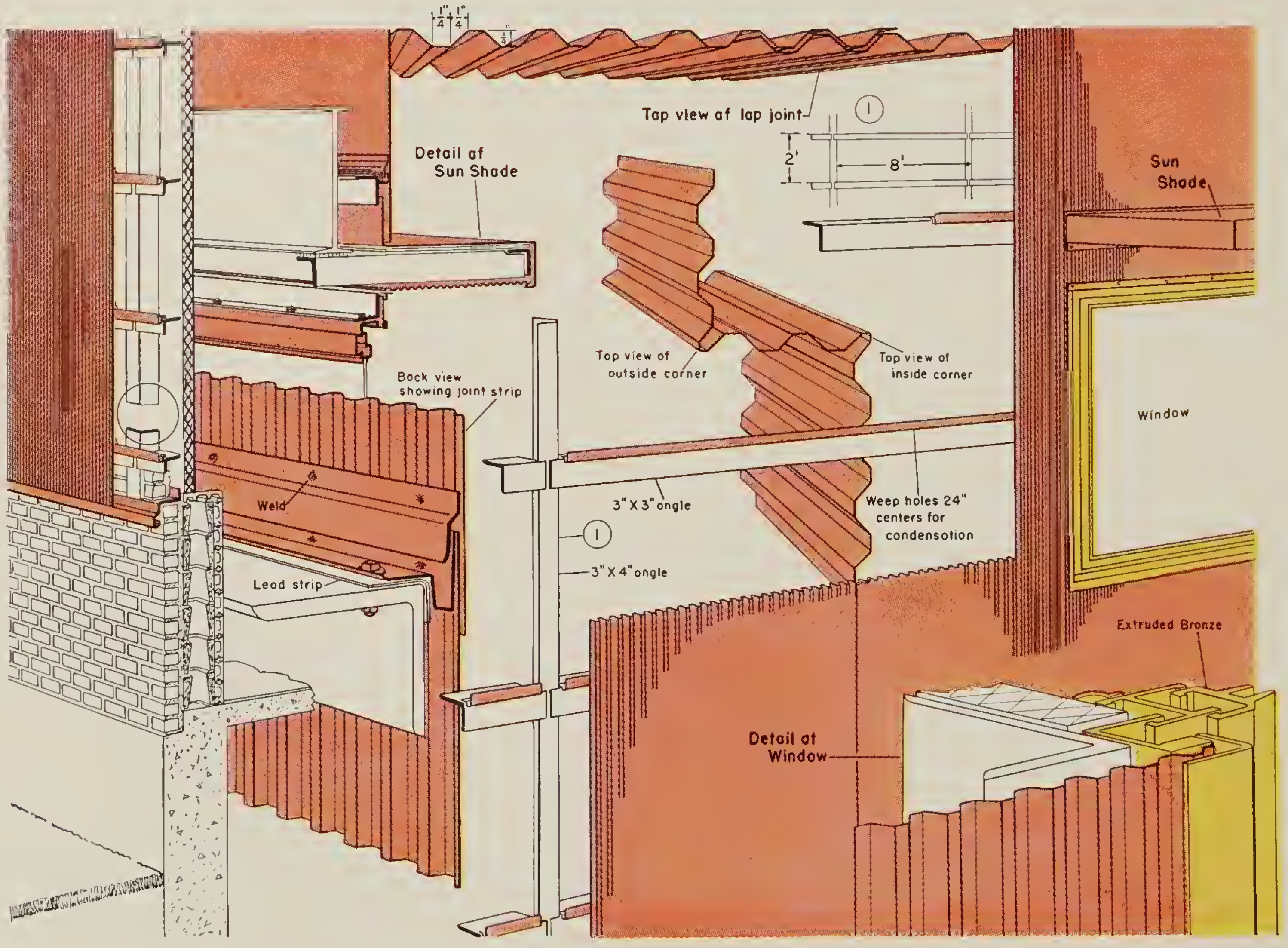
Weather-lapped joints

Metal facings, one story high, with fine corrugations, weather-lapped at ends and sides, make a nice appearance and are relatively inexpensive. This type of facing with channeled corrugations 1/4″ deep and 1″ centers can be made advantageously with 24-ounce Copper of cornice temper. Horizontal joint strips, spot welded or soldered to the reverse side of the corrugated sheets at 24″ intervals vertically, add stiffness and provide sliding connections at the horizontal girts of the structural framing.



Curtain-wall construction using fine Corrugated Copper Facing.

DETAIL OF FINE CORRUGATED METAL FACING

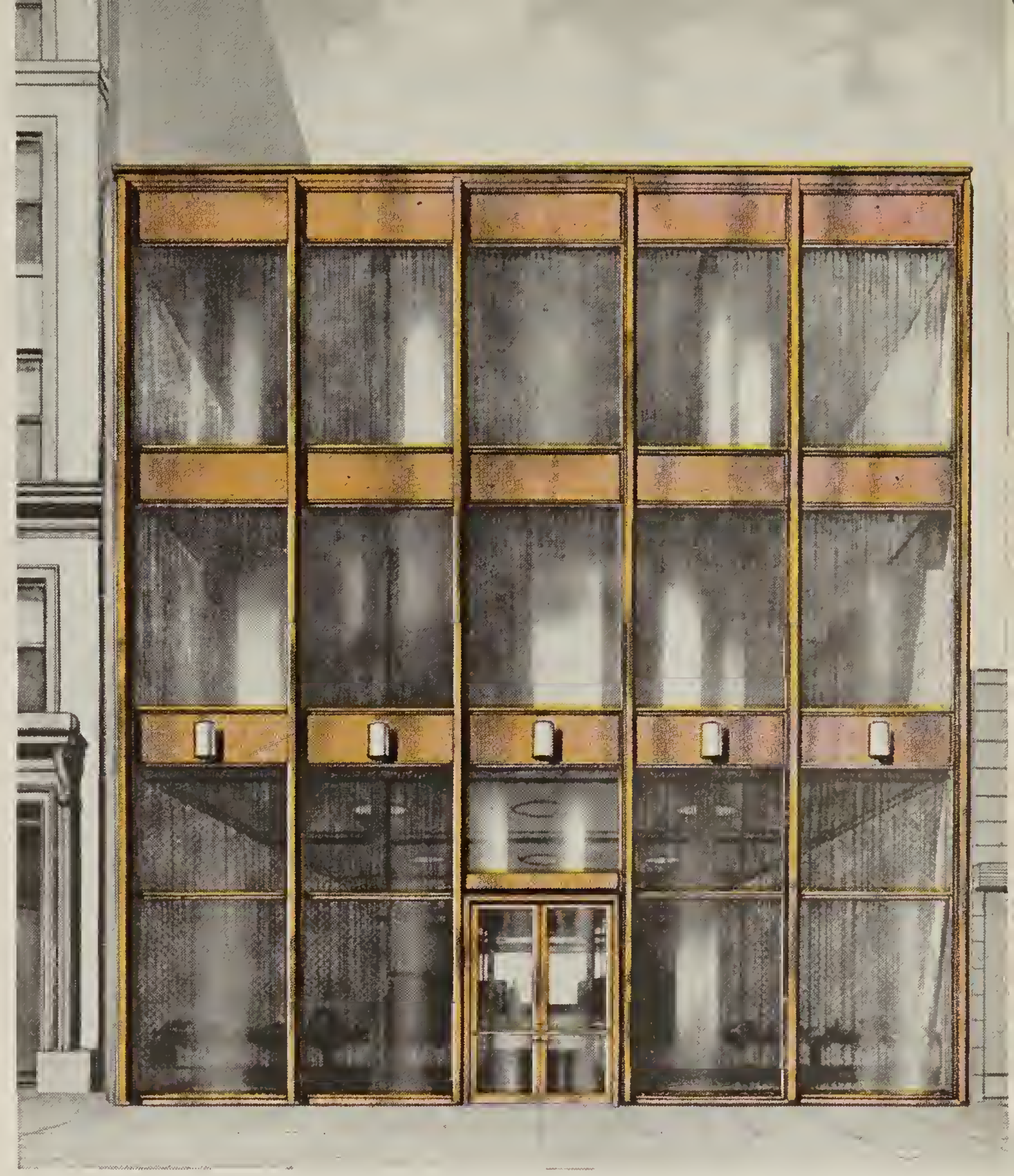


EXTRUDED SHAPES AND HEAVY-GAGE FLAT METAL

Metal grid of "spars and bars"

These are well suited to the grid type of curtain wall. Such construction insures a trim appearance and the least likelihood of buckling. Contributing factors are the inherent stiffness of the extruded members and the clearances in the cut-off type expansion joints, vertical and horizontal, plus the use of heavy-gage, free-sliding Muntz Metal spandrels.

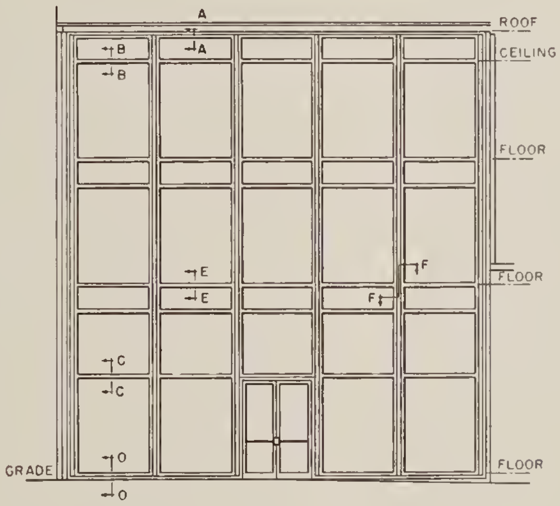
The bronze front on the Northeastern Pennsylvania National Bank and Trust Company building is typical of the grid system, although differing somewhat in detail. Curtain-wall sections of this type are strong and permit easy fabricating and installing with modern handling equipment. The three-story sections at the bank were fabricated and erected in one piece from top to bottom. There are slotted hole connections at the floors and roof, and clearance is allowed at floors and ceilings for expansion and contraction. *Architect's rendering at right.*



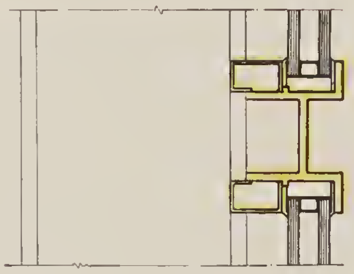
NORTHEASTERN PENNSYLVANIA NATIONAL BANK AND TRUST COMPANY

George M. D. Lewis, Architect
Scranton, Pennsylvania

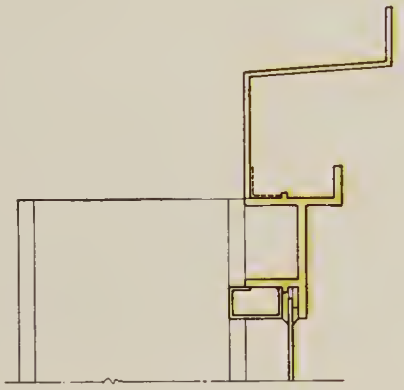
Standard Iron Works, Fabricator
Scranton, Pennsylvania



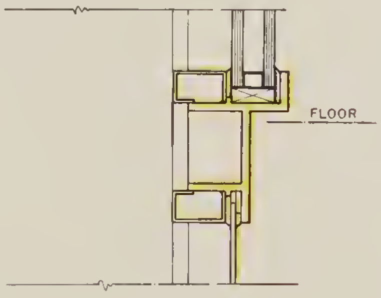
FRONT ELEVATION



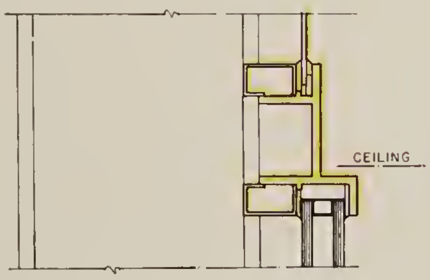
WINDOW BAR SECTION C-C



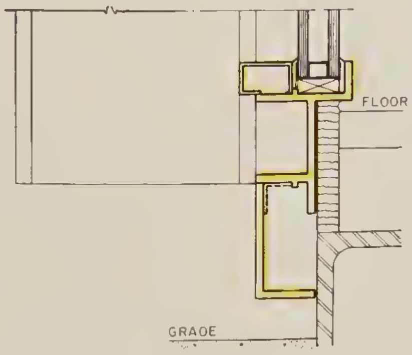
CROWN SECTION A-A



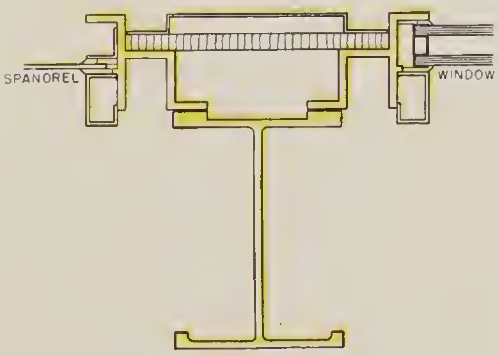
SILL SECTION E-E



WINDOW HEAD SECTION B-B



BOTTOM SILL SECTION D-D



MULLION SECTION F-F

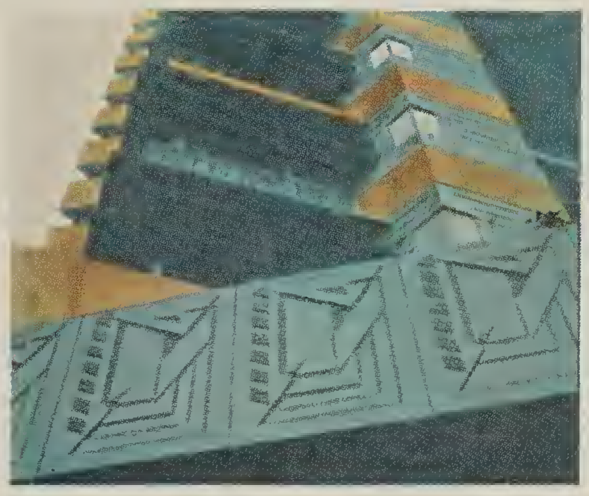
chapter 4

BUILDINGS OF OUTSTANDING DESIGN, WITH CONSTRUCTION DETAILS

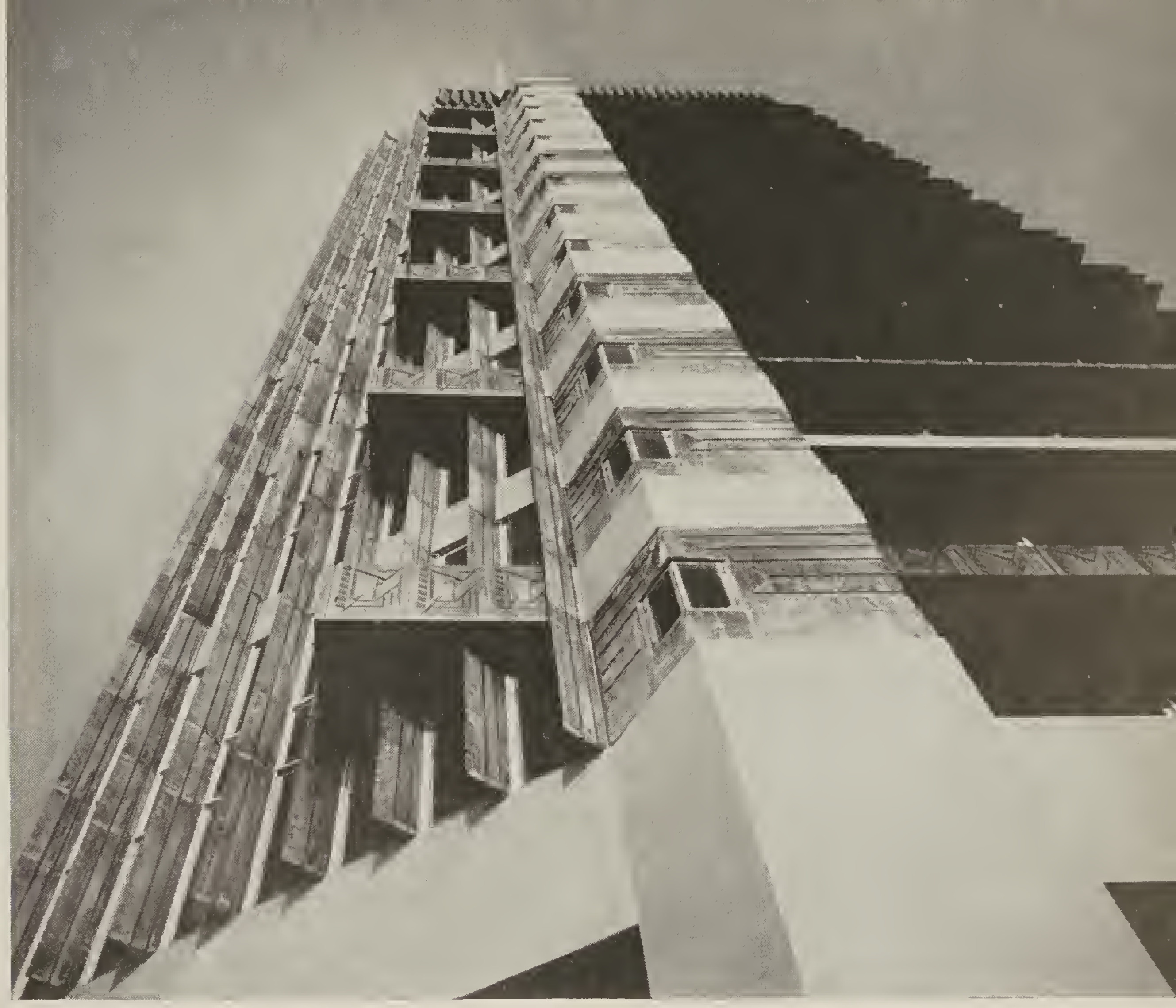
THE PRICE TOWER
BARTLESVILLE, OKLAHOMA

Organic architecture with patinated Copper and tinted concrete. The Sheet Copper was stamped and creased to produce an architectural pattern, and artificially colored to obtain the weathered effect.

Frank Lloyd Wright, Architect
Spring Green, Wisconsin



Detail of band course.



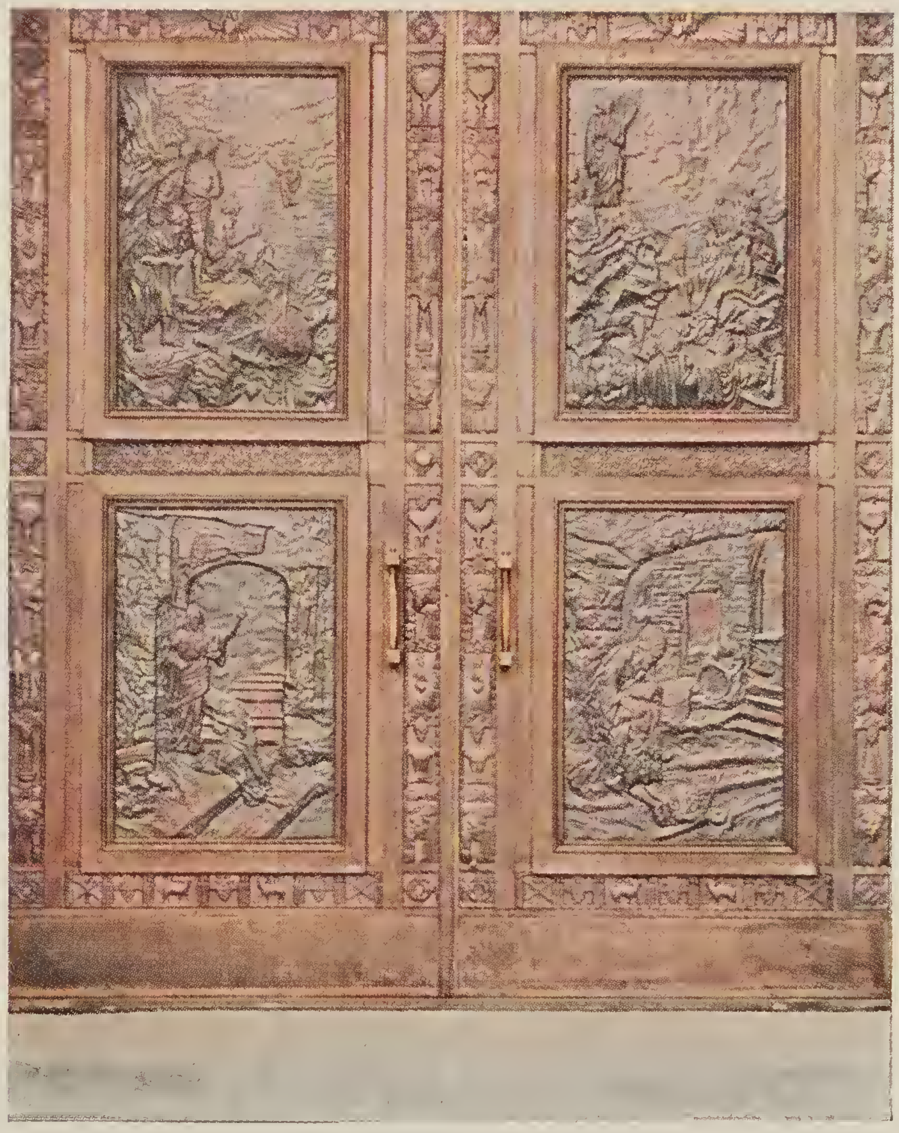
View showing Copper-covered balconies and vertical sunshades.

CATHEDRAL DOORS OF COPPER AND EXTRUDED BRONZE

This set of double doors is one of six that were required for the Valleyfield Cathedral in the Province of Quebec. Each door is 38″ wide and 120″ high, and consists of a steel frame, Extruded Bronze rims and a Copper facing.

These doors are unique in that the decorative designs in the panels, stiles and rails were executed in what is known as repoussé. By this art the sculptor works first on the reverse side of Sheet Copper with blunt tools and then models the face with finer tools, making indentations that finally result in the finished work of art. Cold-rolled-and-annealed Copper of 20-ounce gage is commonly used.

Marschner & Company, Fabricator
Cowansville, Province of Quebec



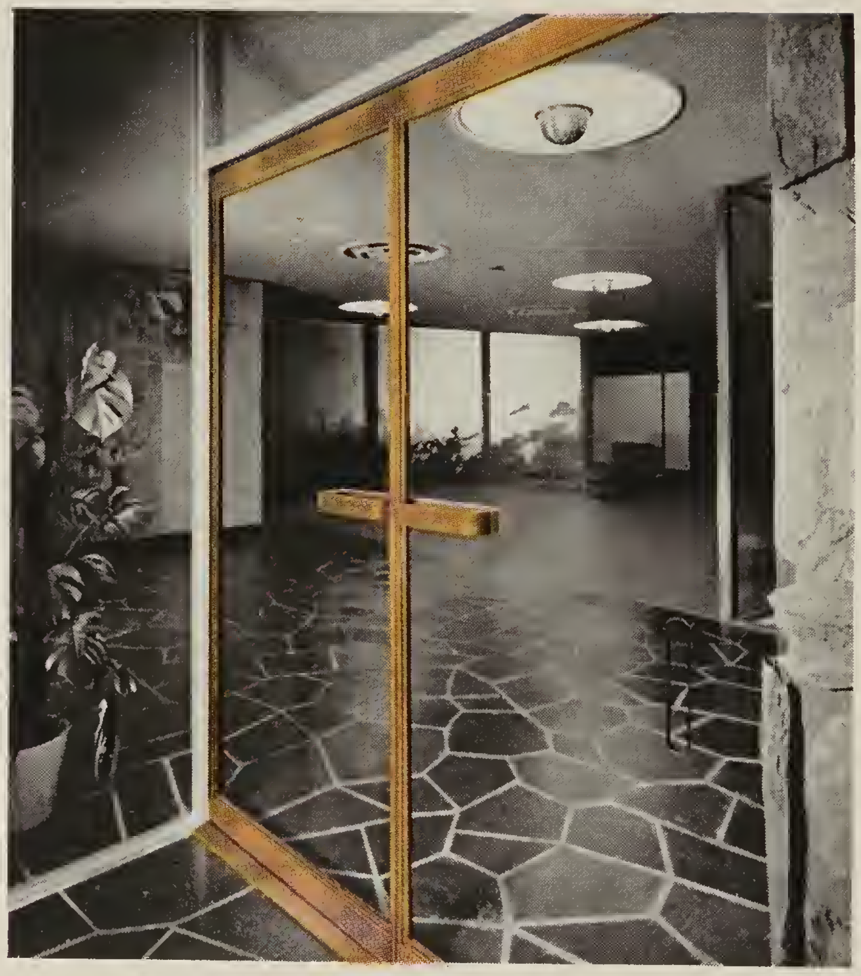
ADMINISTRATION BUILDING
ROSE HILLS MEMORIAL PARK, WHITTIER, CAL.

The Extruded Architectural Bronze and the Red Brass in the architecture of this building represent a good selection and modern use of these materials. The sunshade louvers of Extruded Bronze are substantial enough to be permanently straight and strong. Shapeliness is a favorable characteristic of Extruded Bronze, which is ordinarily heavier in gage than sheet or tubular stock. This, together with the warmth of color and the crispness of its sharp arrises, make Extruded Bronze the leader of Architectural Metals.

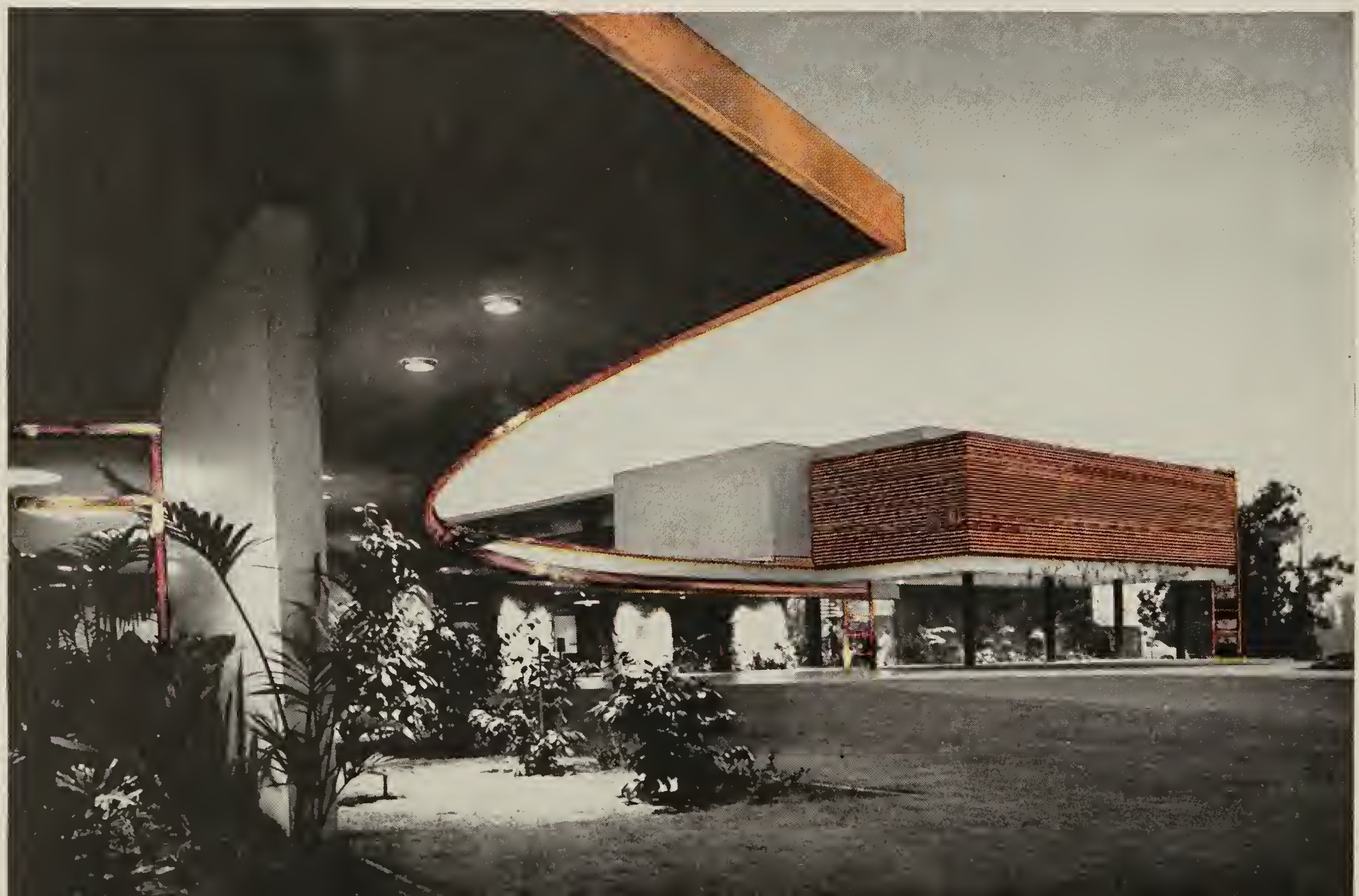
The architectural motif of free-standing, ladder-type frames of Bronze and figured glass has originality. The frames afford an opportunity to use a decorative material, Red Brass, as a sleeve over a structural steel channel to obtain both strength and beauty at lowest cost. Red Brass and Architectural Bronze are companion metals in architectural design. They weather almost alike and make an acceptable color match when finished in the natural color of the new metals.

Albert C. Martin & Associates, Architects
Los Angeles, California

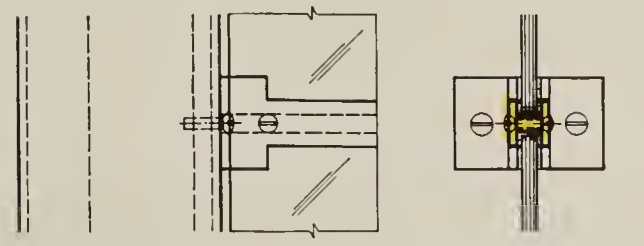
A. J. Bayer Company, Fabricator
Los Angeles, California

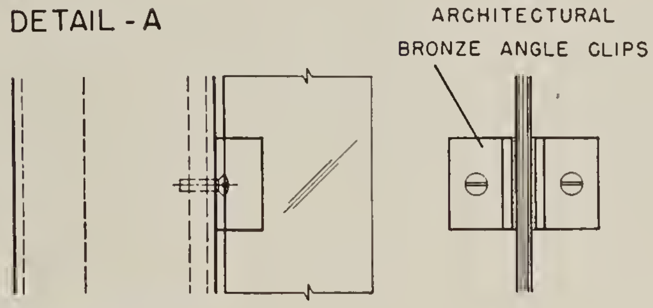


Curved section of jambs and the stiles, rails, push bars and thresholds of exterior doors are Bronze extrusions.

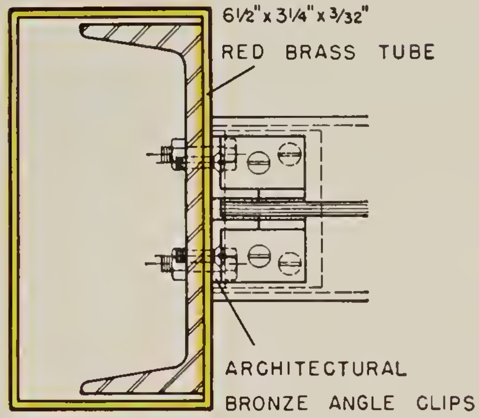


ROSE HILLS MEMORIAL PARK ADMINISTRATION BUILDING

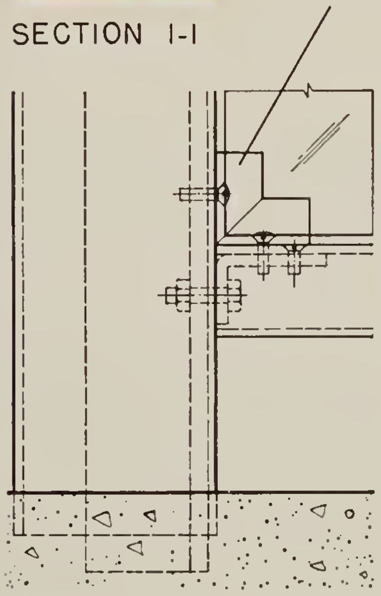

DETAIL - A

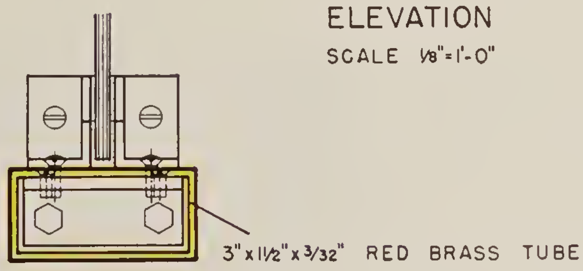


DETAIL - B

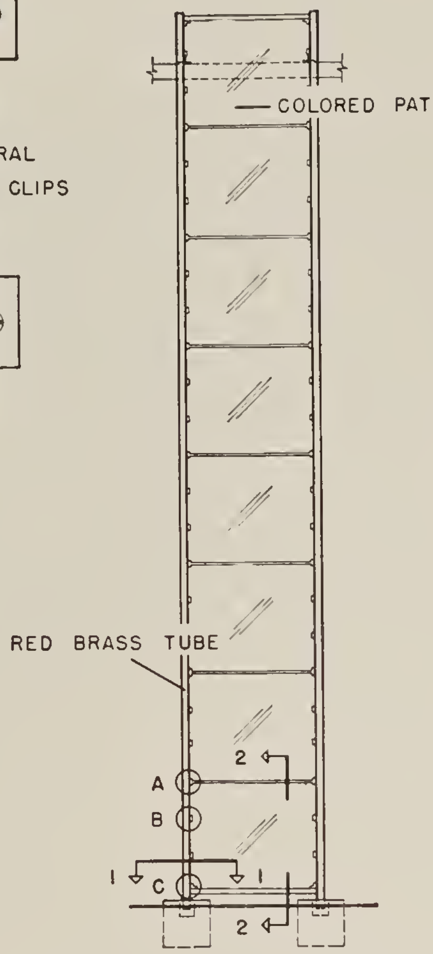


SECTION 1-1

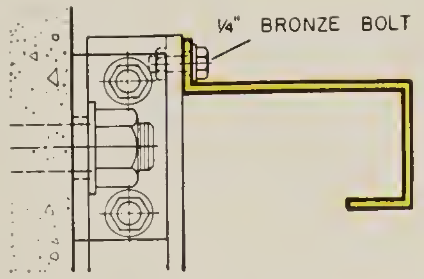

DETAIL - C

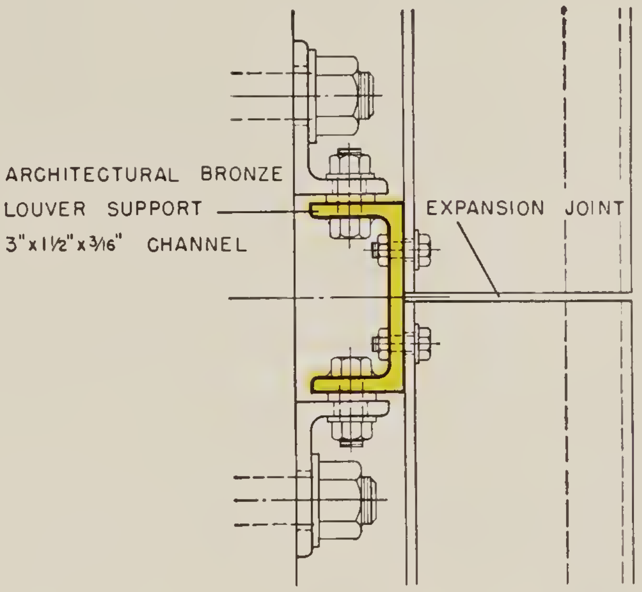


SECTION 2-2

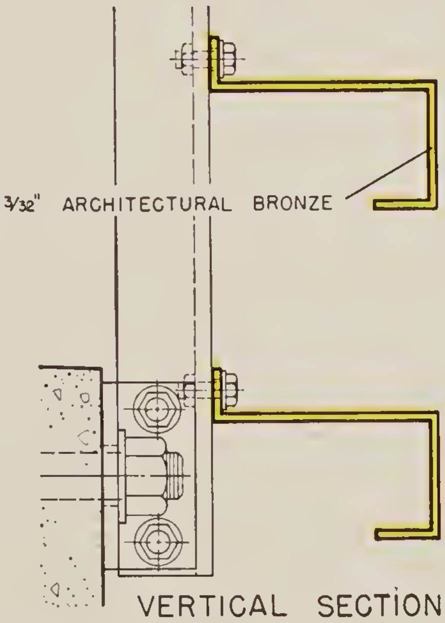


GLASS SCREEN
ELEVATION
SCALE ⅛" = 1'-0"



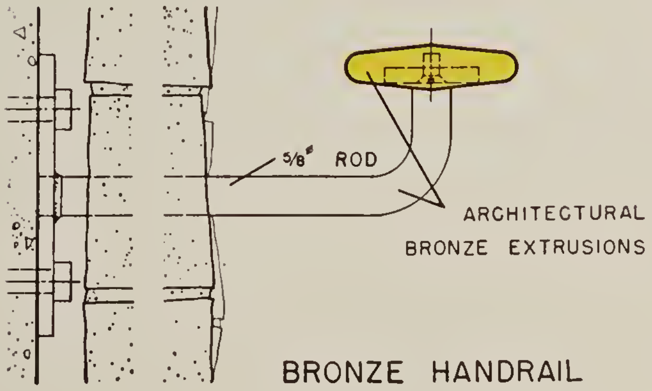


HORIZONTAL SECTION

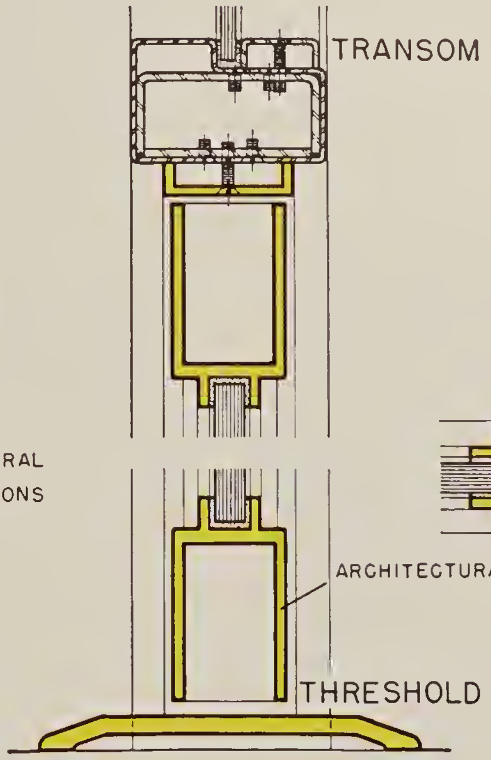


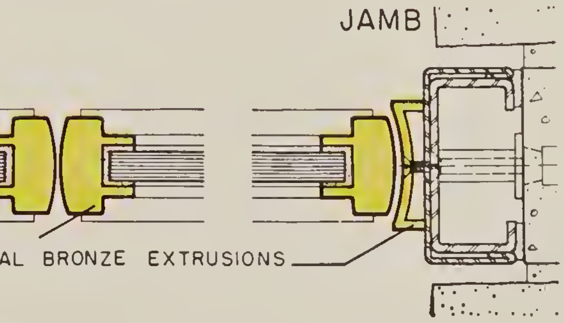
VERTICAL SECTION

EXTRUDED BRONZE LOUVERS



BRONZE HANDRAIL





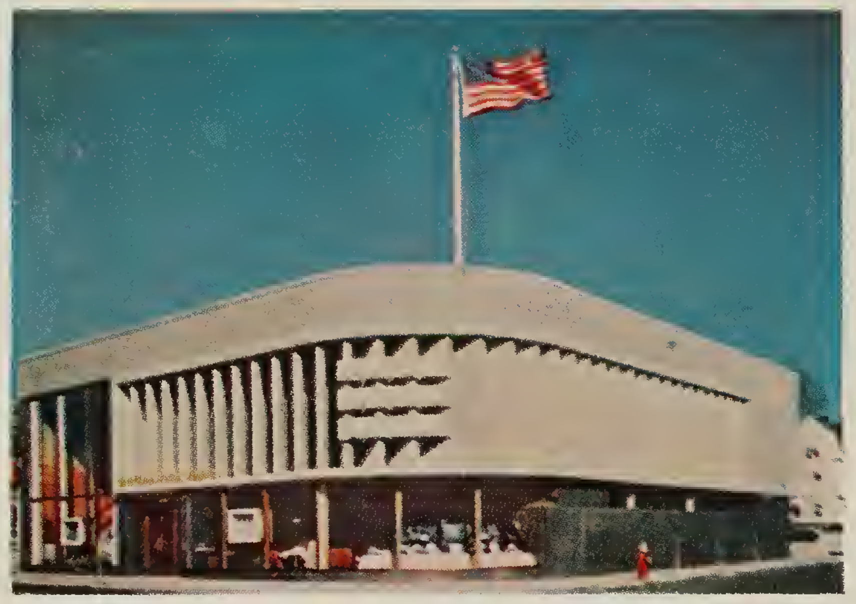
BRONZE DOOR SECTIONS

SCALE 3" = 1'-0" UNLESS OTHERWISE NOTED

WATERTOWN FEDERAL SAVINGS AND LOAN ASSOCIATION
WATERTOWN, MASSACHUSETTS

This bank building has the proper combination of Bronze and other quality building materials to make an interesting composition, in good taste and rich in character.

In this architecture the normal-size sections are made of Extruded Bronze; the tubular mullions and flat surfaces such as the segmental window sills are of Muntz Metal sheet. The architects made good use of complementary materials, both inside and outside the building. The Bronze doors have wooden grips of imaginative detail, and the tall mullions enhance the beauty of the large plate glass windows. Inside, there is an attractive Bronze stair rail of modern design set off against a buttress of white marble. In addition, a background of Bronze-framed windows and the Bronze entrance doors add cheerfulness to the over-all scene.

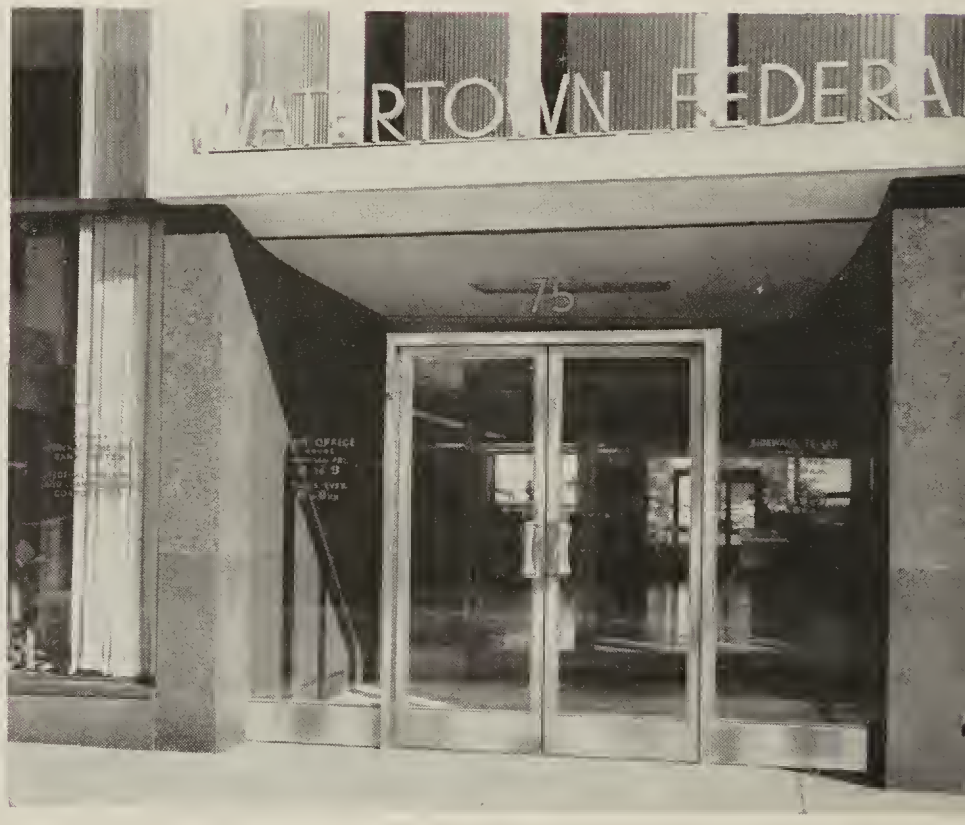


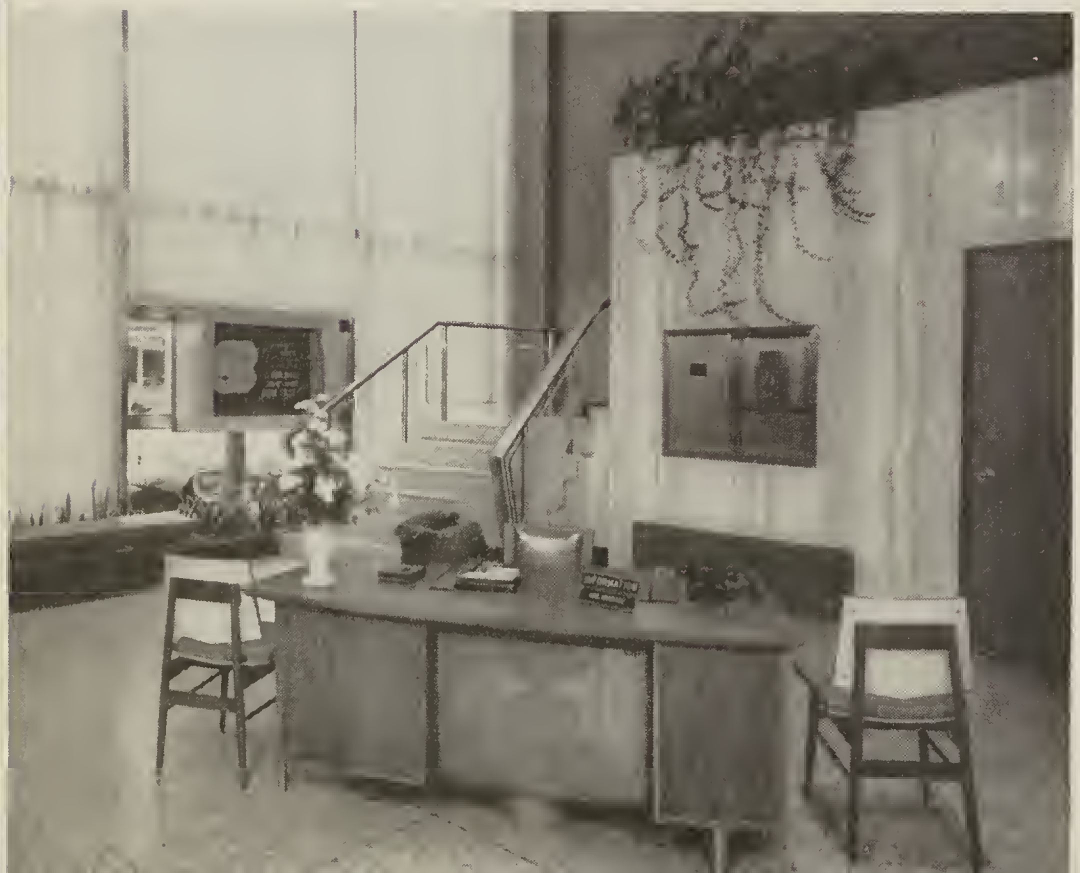
A. F. Gilbert & Son, Architects
New York, N. Y.

Davis Hamerstrom, Associate Architect
Roscoe, N. Y.

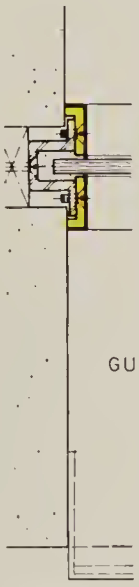
Thomas Benedict, Designer
Roscoe, N. Y.

E. T. Ryan Iron Works, Inc., Fabricator
Boston, Massachusetts

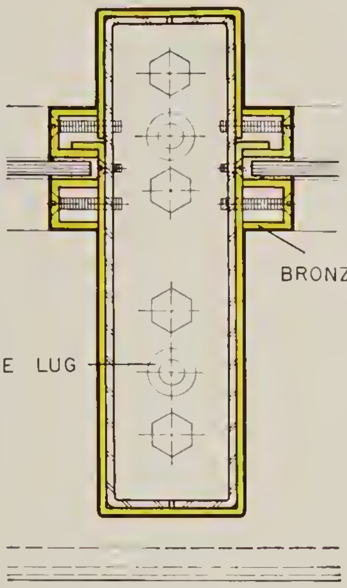




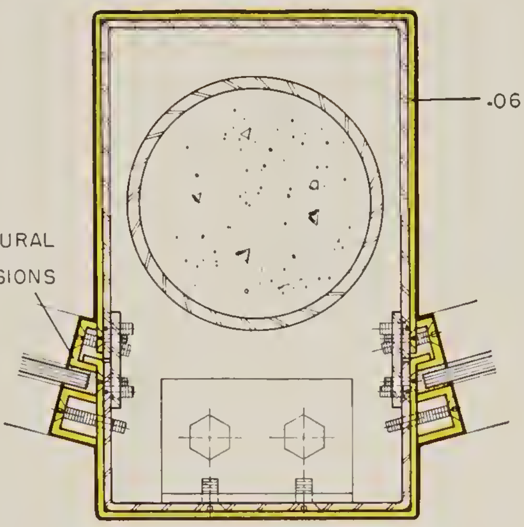
WATERTOWN FEDERAL SAVINGS AND LOAN ASSOCIATION



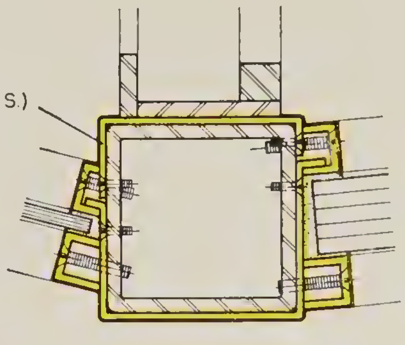
JAMB



MULLION - A

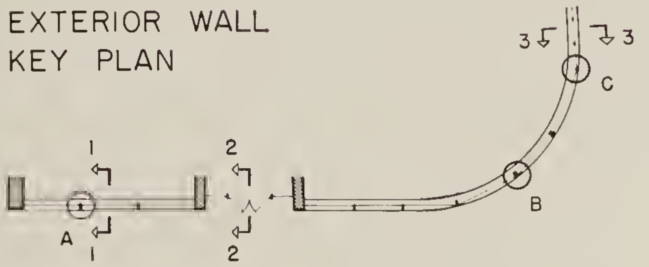


MULLION - B

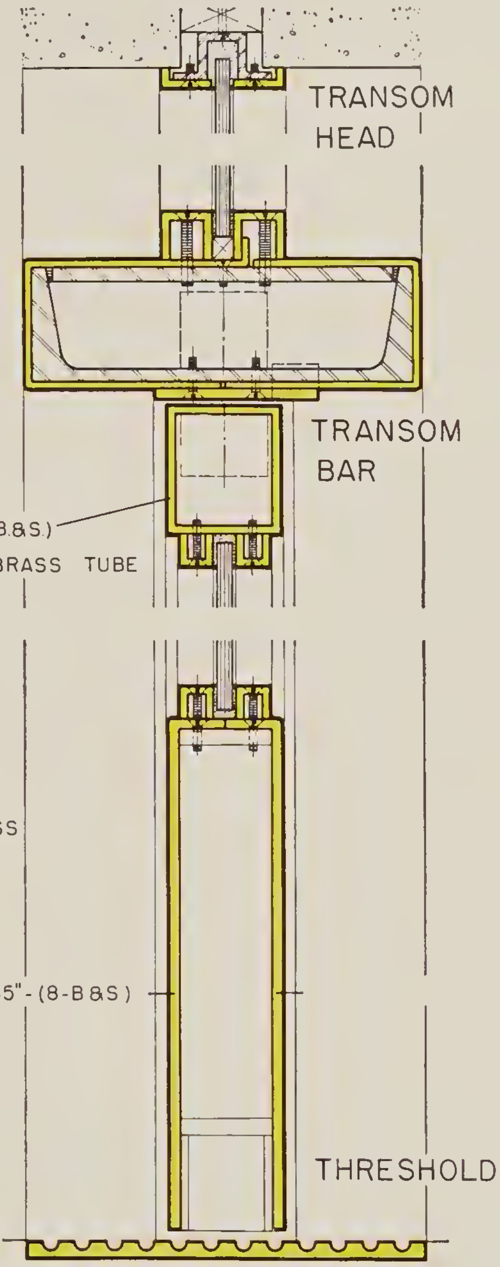


MULLION - C

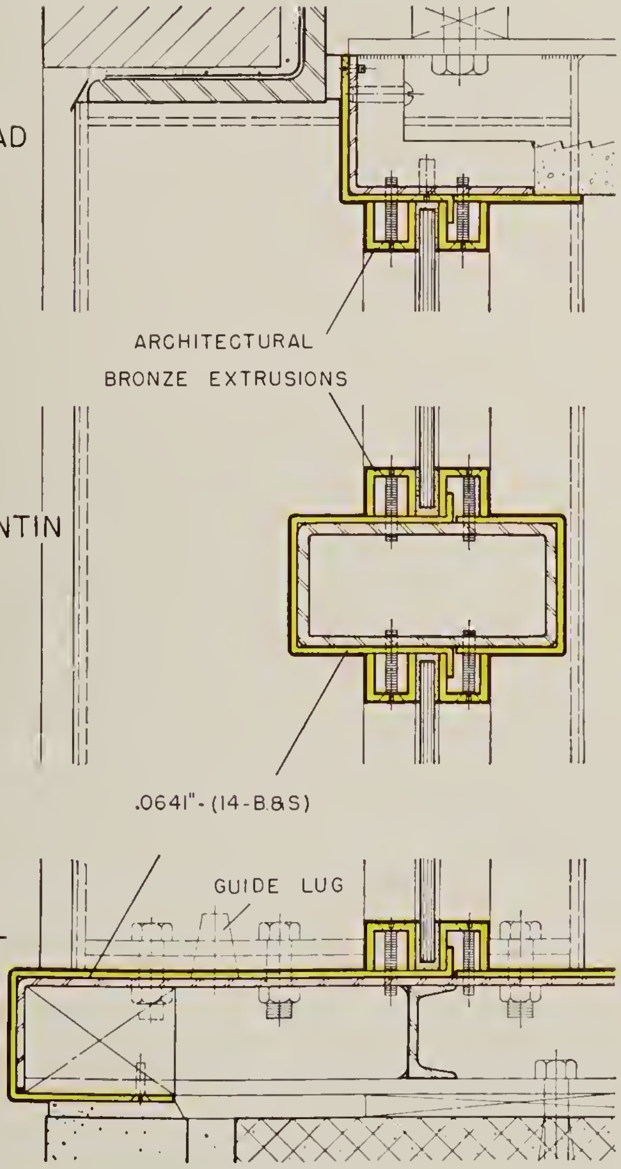
EXTERIOR WALL
KEY PLAN



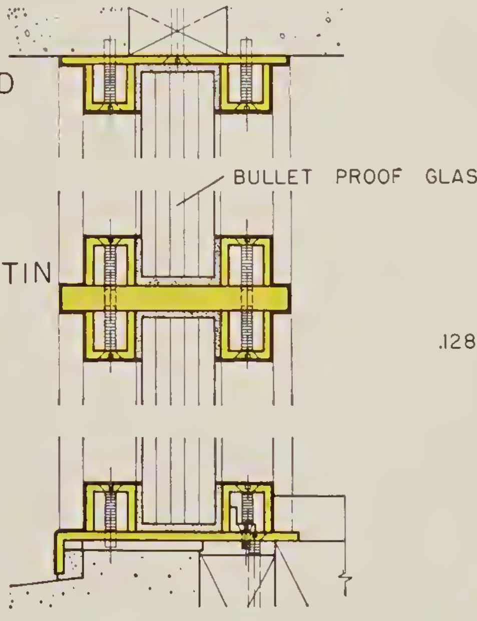
ALL DETAILS SCALE 3"=1'-0"



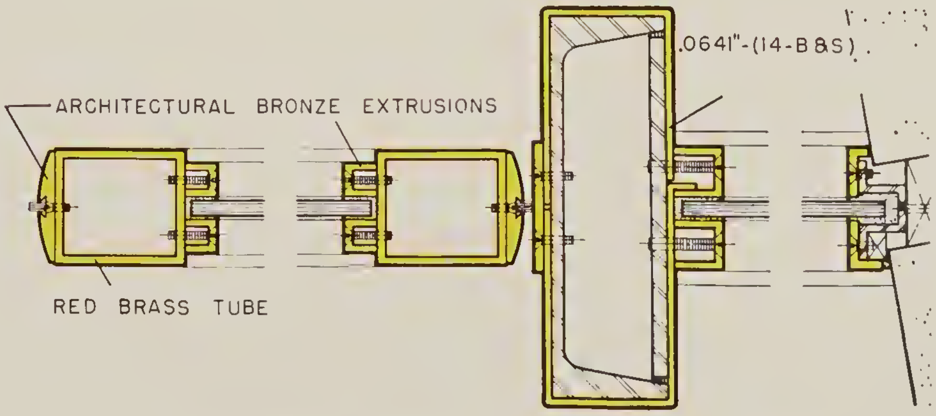
SECTION 2-2



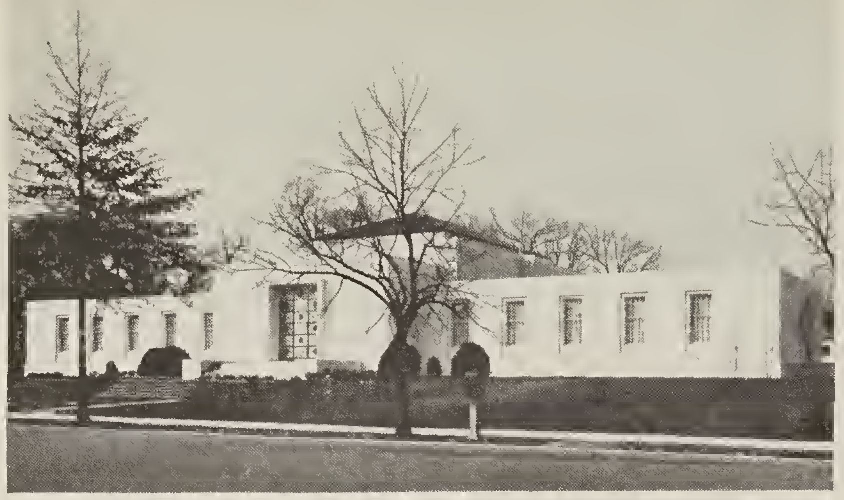
SECTION 1-1



SECTION 3-3



HORIZONTAL DOOR & FRAME SECTION



UNITED DAUGHTERS OF THE CONFEDERACY HEADQUARTERS BUILDING RICHMOND, VIRGINIA

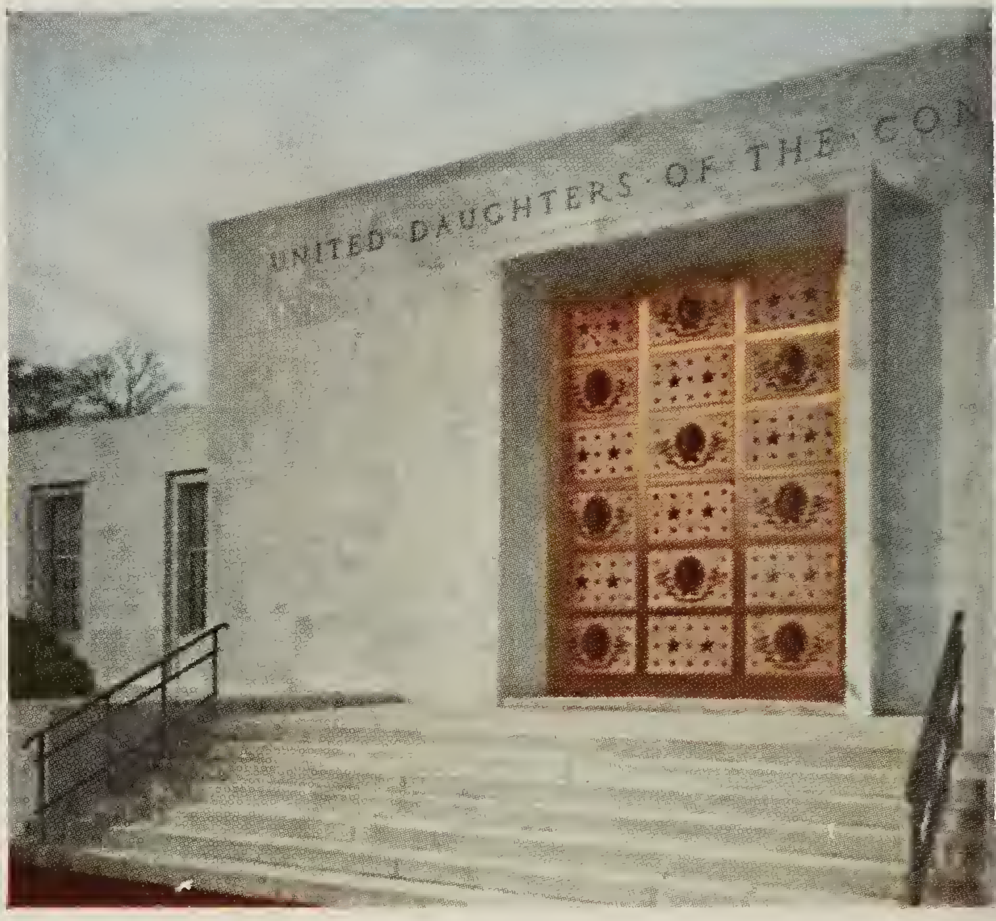
This Bronze entrance is a dignified and noble work of art. It is modern in every sense and embodies advanced ideas in architectural metalwork.

The assembly consists of tubular steel framework over which a 16-gage Red Brass facing is applied. The panels are raised, rolled or dished, and some are flat with implanted Cast Bronze ornament, all designed to eliminate the possibility of buckling.

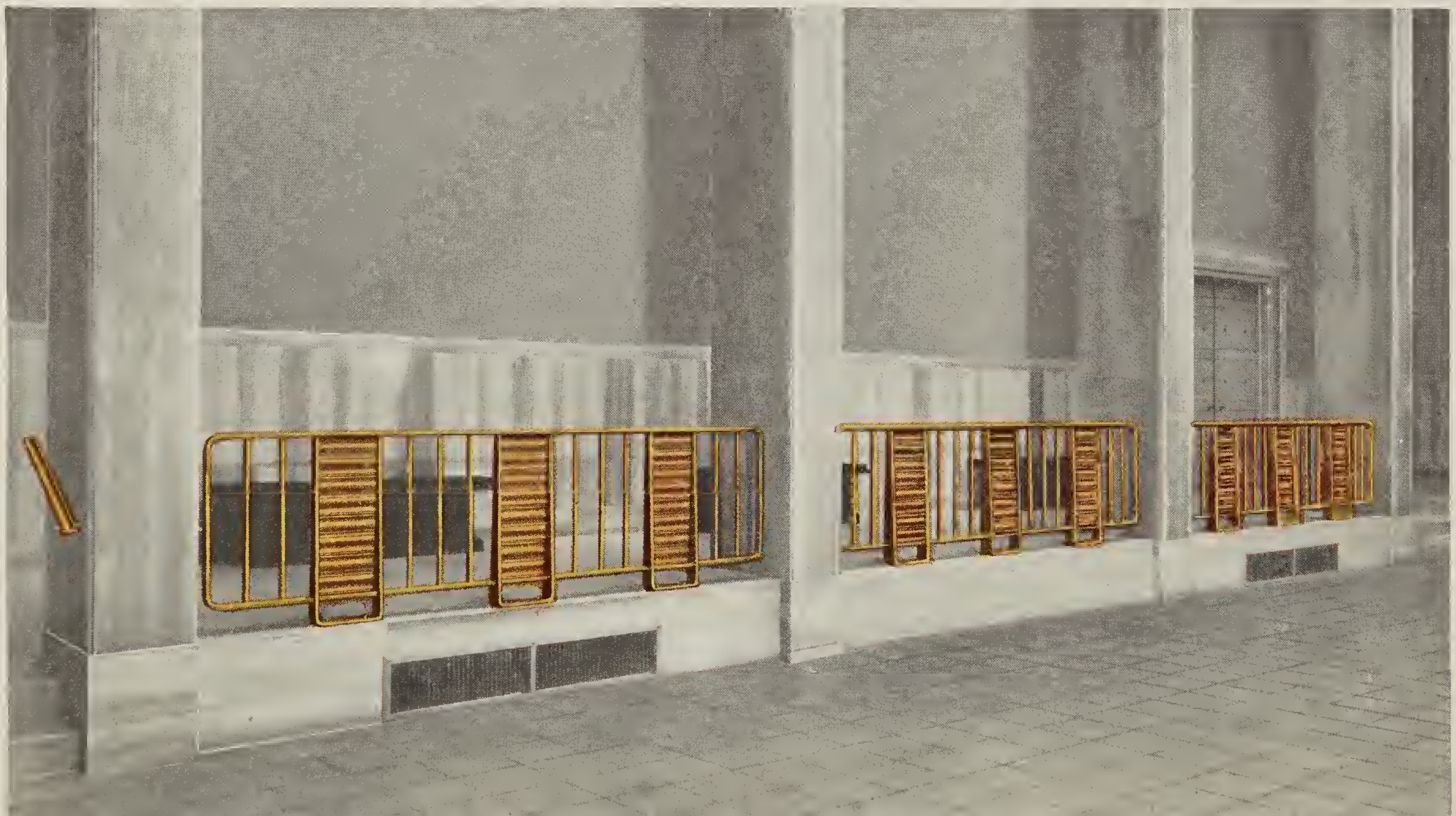
A notable feature of this design is that Extruded Bronze, which is usually the predominating material in an architectural composition, is used sparingly. The cotton blossom is the principal architectural and symbolic motif, and is executed masterfully in Cast Bronze.

Ballou and Justice, Architects
Richmond, Virginia

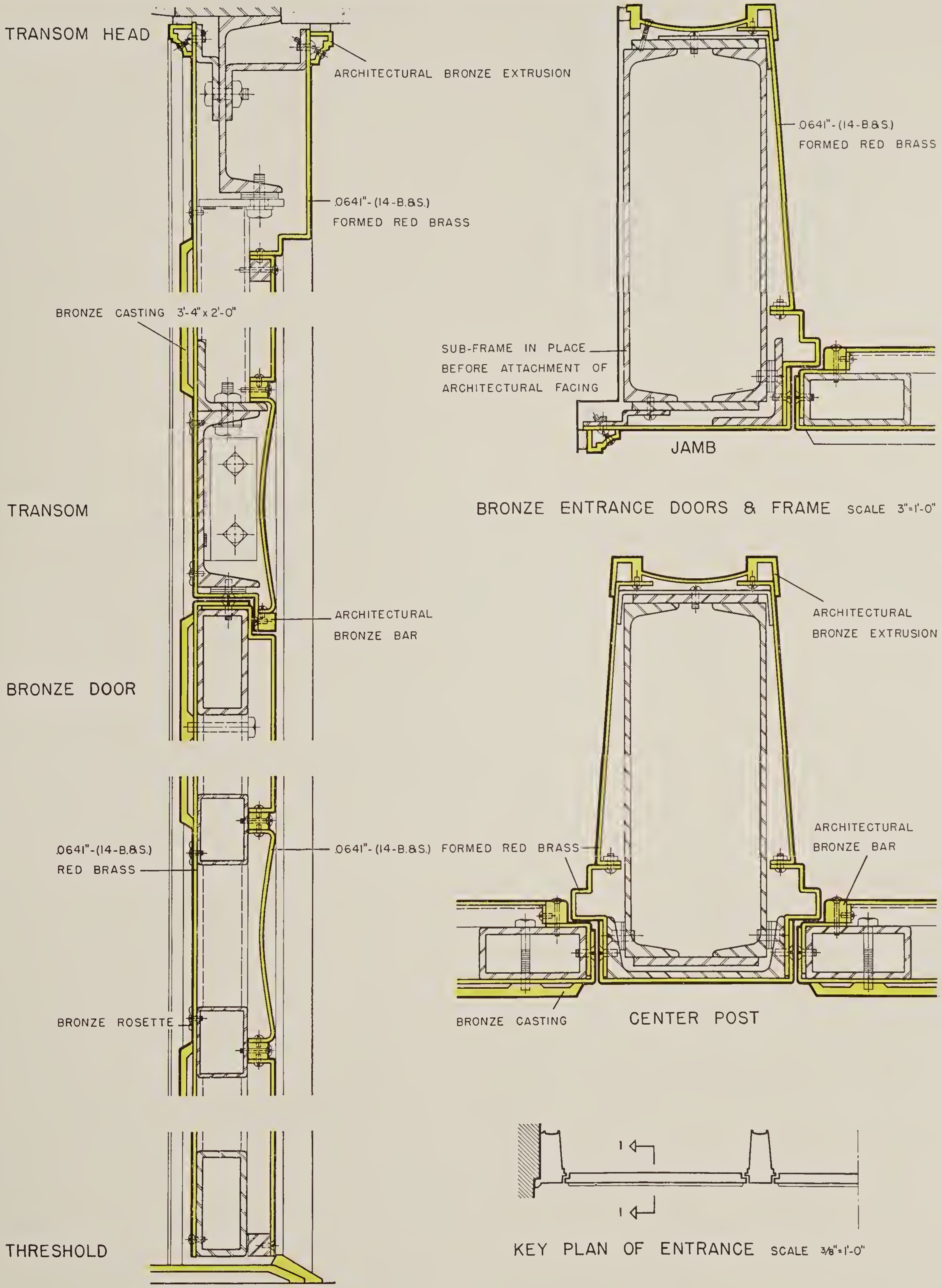
Usona Manufacturing Company, Fabricator
St. Louis, Missouri



Railings of Extruded Bronze with panels of interlocking extrusions.



UNITED DAUGHTERS OF THE CONFEDERACY HEADQUARTERS BUILDING


TRANSOM HEAD
ARCHITECTURAL BRONZE EXTRUSION
.0641"-(14-B.&S.) FORMED RED BRASS
BRONZE CASTING 3'-4" x 2'-0"
TRANSOM
ARCHITECTURAL BRONZE BAR
BRONZE DOOR
.0641"-(14-B.&S.) RED BRASS
.0641"-(14-B.&S.) FORMED RED BRASS
BRONZE ROSETTE
THRESHOLD
.0641"-(14-B.&S.) FORMED RED BRASS
SUB-FRAME IN PLACE BEFORE ATTACHMENT OF ARCHITECTURAL FACING
ARCHITECTURAL BRONZE EXTRUSION
ARCHITECTURAL BRONZE BAR
BRONZE CASTING

VERTICAL SECTION I-I

JAMB

CENTER POST

BRONZE ENTRANCE DOORS & FRAME SCALE 3"=1'-0"

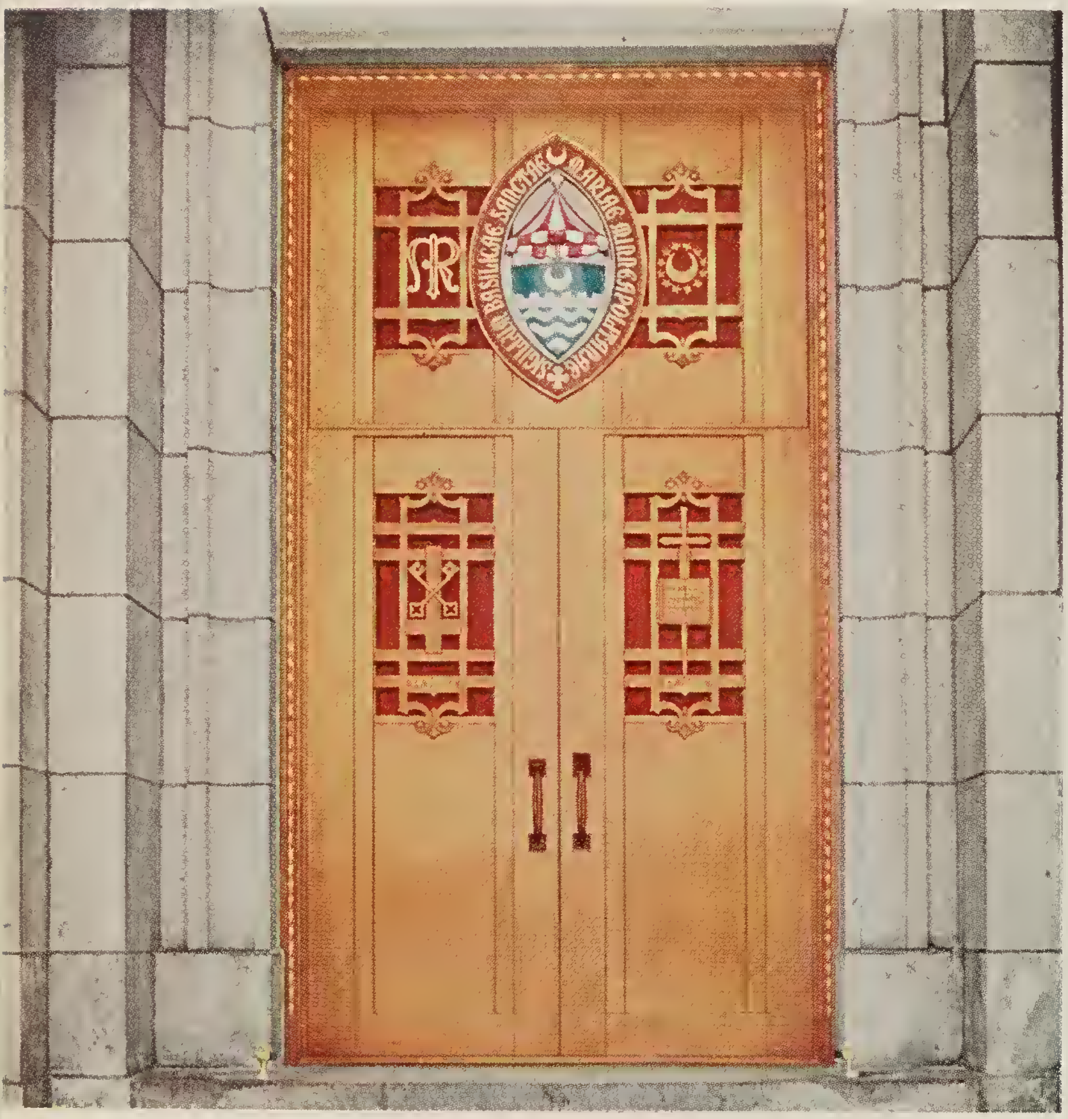
KEY PLAN OF ENTRANCE SCALE 3/8"=1'-0"

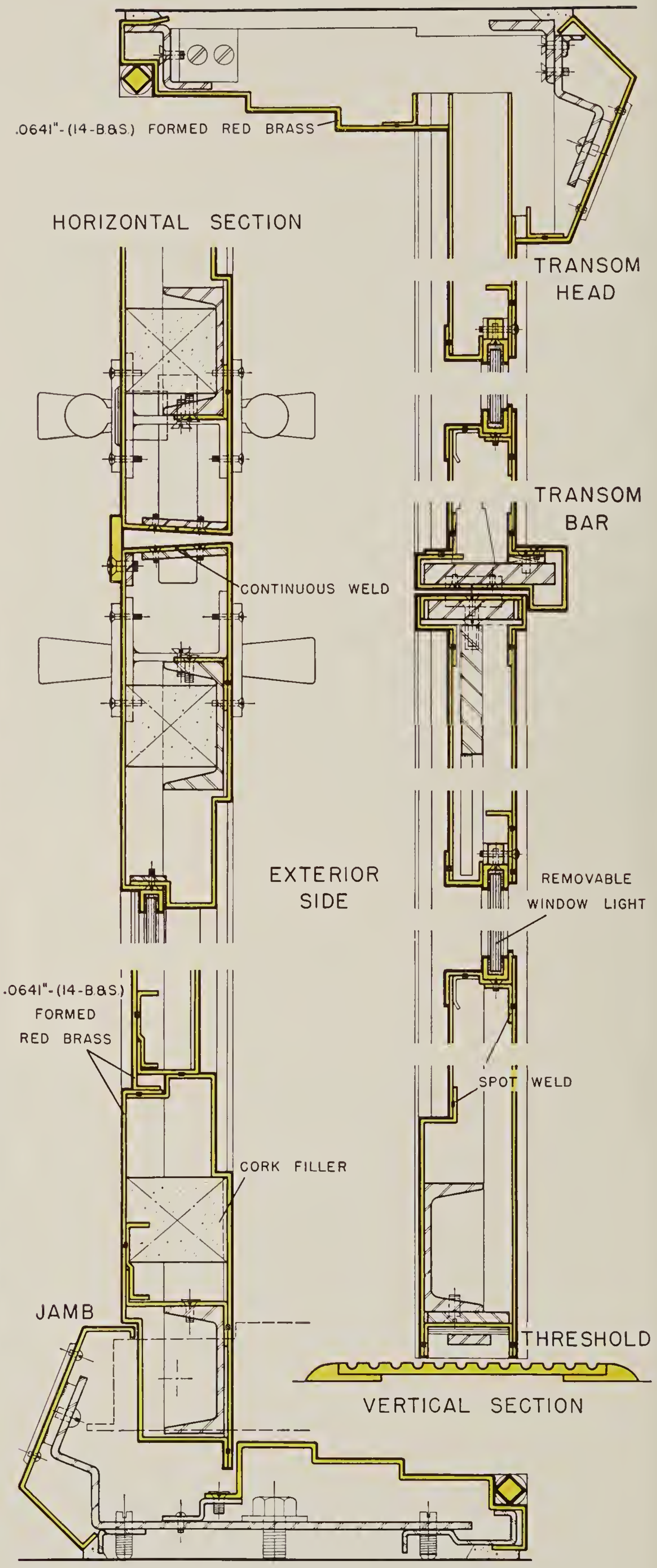
BRONZE DOORS
TO THE BASILICA OF ST. MARY
MINNEAPOLIS, MINNESOTA

This design is unique in its detail of construction. The architect has accented the color of the metal by employing the art of porcelain enameling in the insigne over the doors.

These doors are not overly large or high; therefore, the bright, natural color of Bronze can be easily maintained by an occasional cleaning and wiping with oil or wax.

Flour City Ornamental Iron Manufacturing Co., Fabricator
Minneapolis, Minnesota





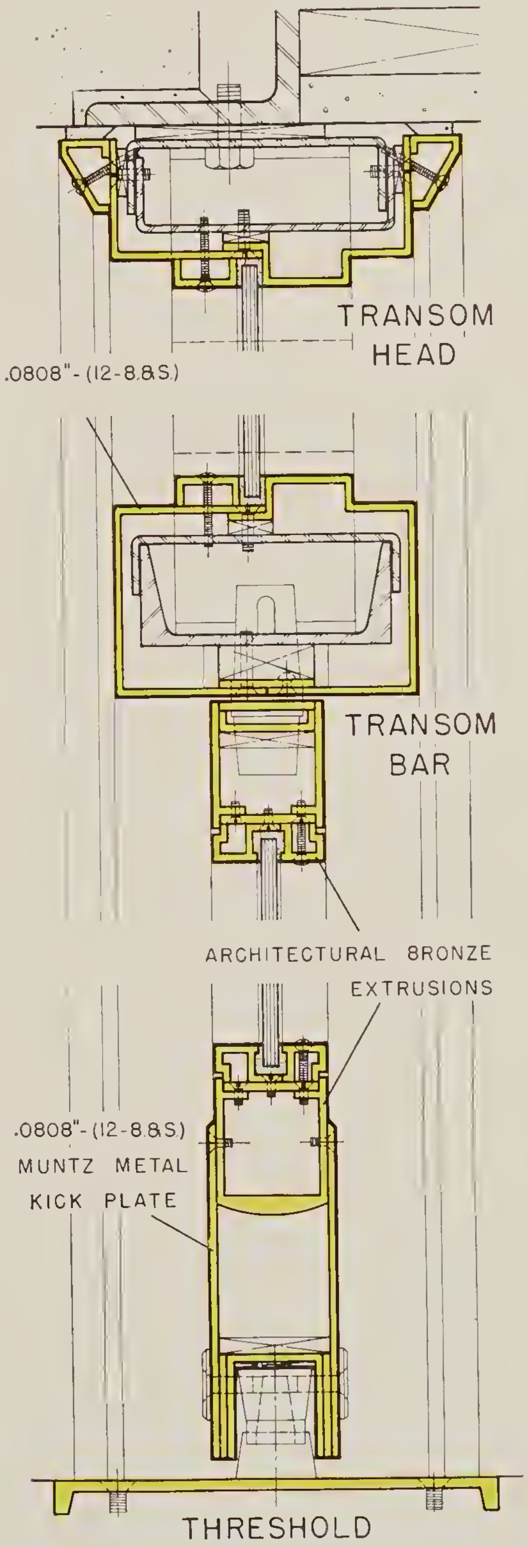
BRONZE ENTRANCE DOORS & FRAME SCALE 3"=1'-0"

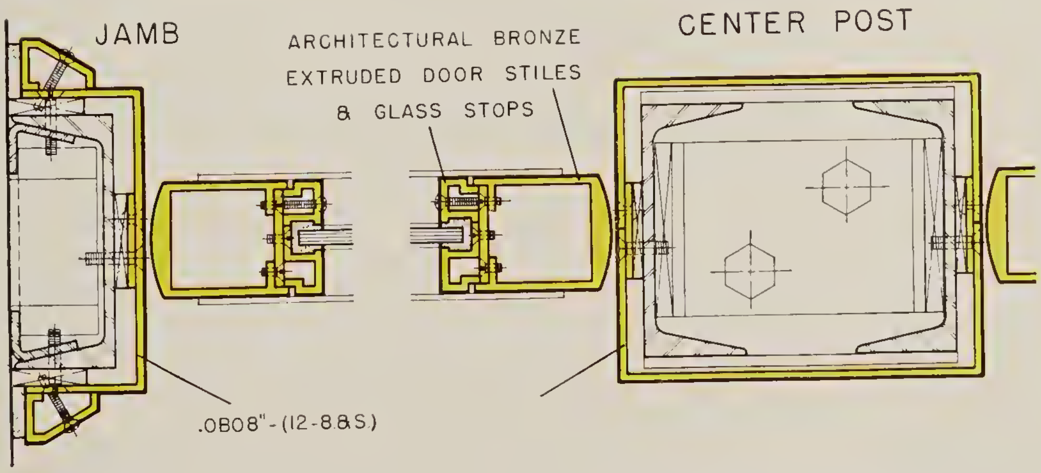
MAISON BLANCHE DEPARTMENT STORE
NEW ORLEANS, LOUISIANA

These doors and frames are of the substantial construction necessary for a busy entrance. In the unusual detail at the glass stops and at the bottom rail of the doors it can be seen that a piece of the extruded stile member is cut-in between the stiles of the door, and has an applied skirting of 12-gage Muntz Metal on the inside and outside. This serves as a kick plate and an open-channel bottom rail for the accommodation of operating mechanism, locking devices, etc.

Goldstein, Parham & Labouisse, Architects
New Orleans, Louisiana

The Michaels Art Bronze Co., Fabricator
Covington, Kentucky


TRANSOM HEAD
.0808"-(12-8.8S.)
TRANSOM BAR
ARCHITECTURAL BRONZE EXTRUSIONS
.0808"-(12-8.8S) MUNTZ METAL KICK PLATE
THRESHOLD



BRONZE ENTRANCE DOORS & FRAME SCALE 3"=1'-0"

ARCHITECTURE IN BRONZE SEAGRAM BUILDING, NEW YORK, N. Y.

This 38-story building, at 375 Park Avenue, was the first curtain-wall type of construction using Extruded Architectural Bronze linear members and heavy Muntz Metal sheet. The stiffness and the well-defined shadow lines of the construction make for the best possible appearance and the least likelihood of objectionable buckling. The Bronze and glass exterior curtain wall is supported by connections to the structural steel at every floor. The weight of each spandrel-window unit is transmitted to the Bronze mullion and, in turn, to the steel framing through a 10-inch-long, heavy Bronze T-bar connector.

Slip joints, ¼-inch open, for expansion and contraction, are provided in each story of height and laterally at all vertical mullions. Slotted bolt holes permit these slip joints to function.

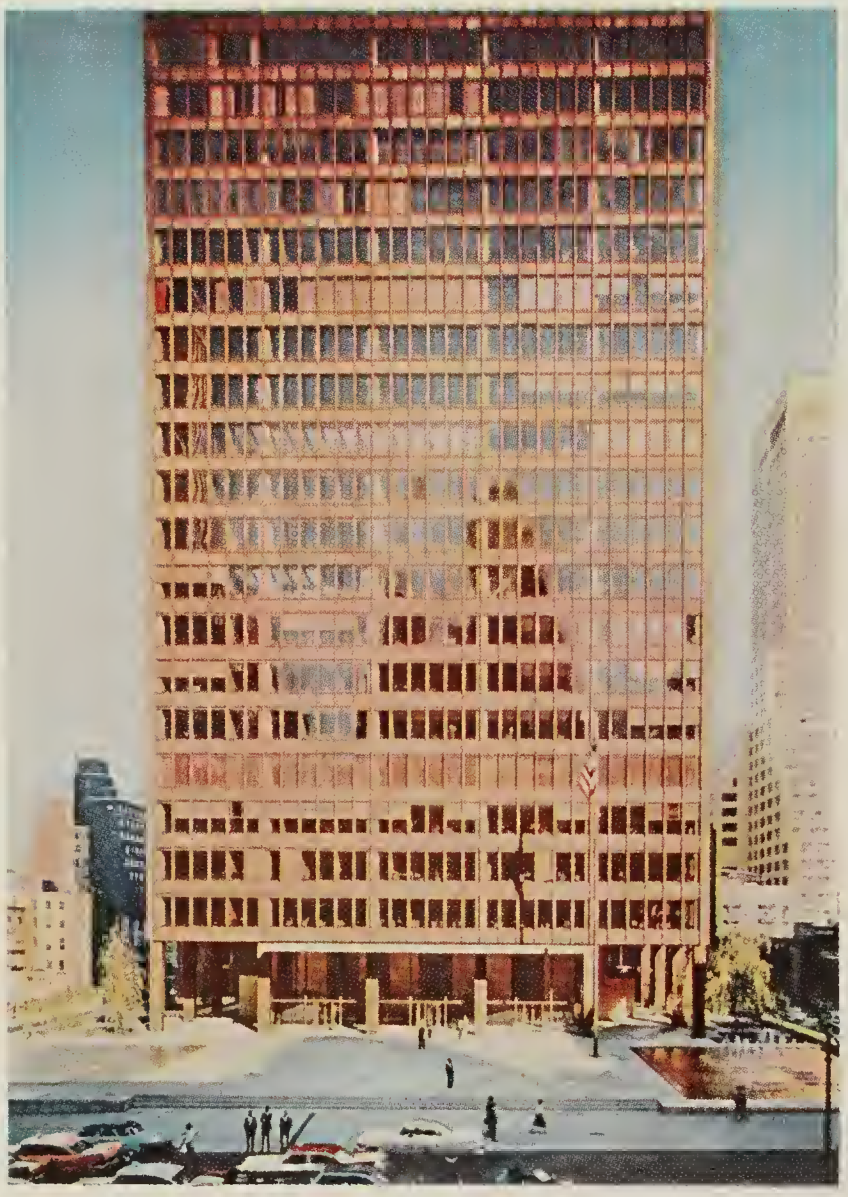
The entire metal facing was given a smooth finish and chemically oxidized to a deep statuary bronze color. In the seacoast atmosphere of New York City the patina will develop in a few years.

Mies van der Rohe and Phillip Johnson, Architects
Chicago and New York

Kahn & Jacobs, Associate Architects
New York, N. Y.

General Bronze Corporation, Fabricator
Garden City, N. Y.

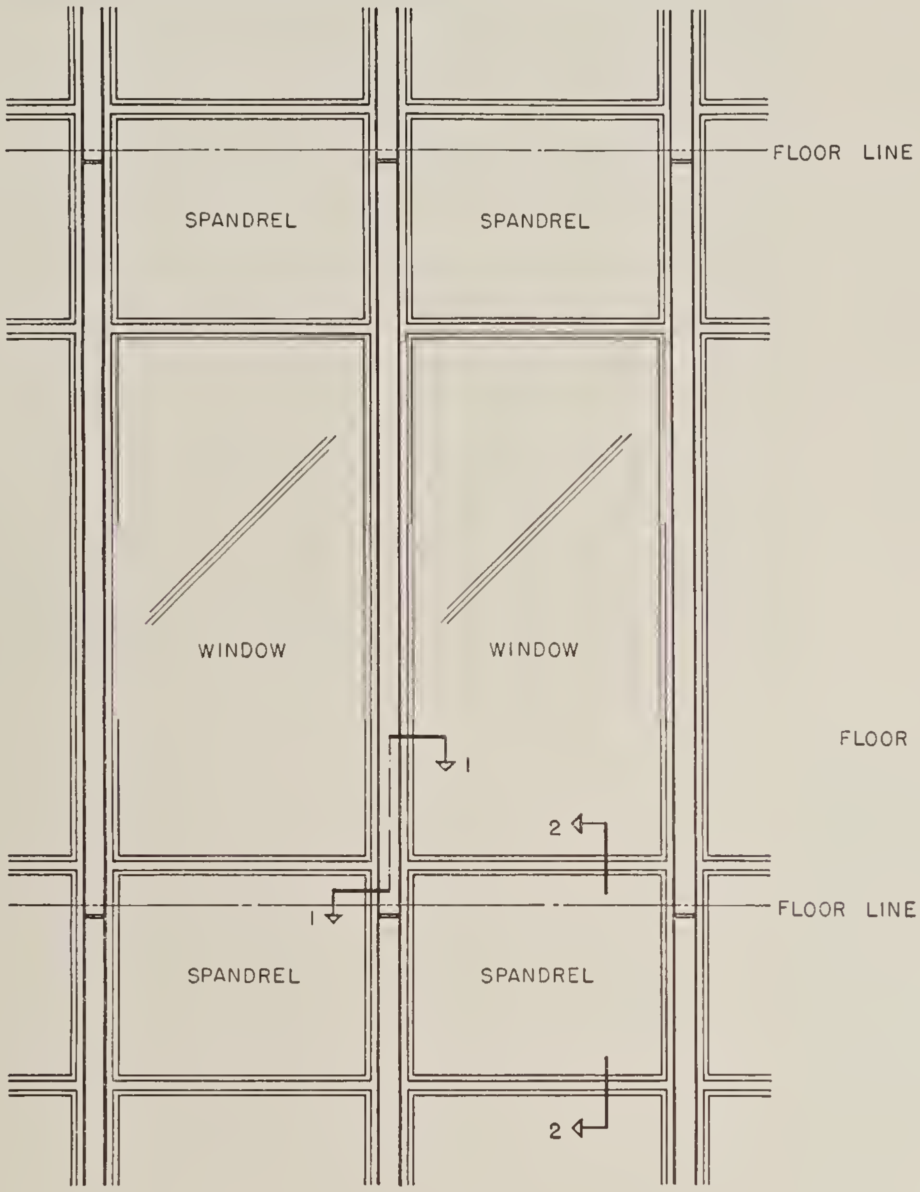
Approach to 52nd Street entrance.

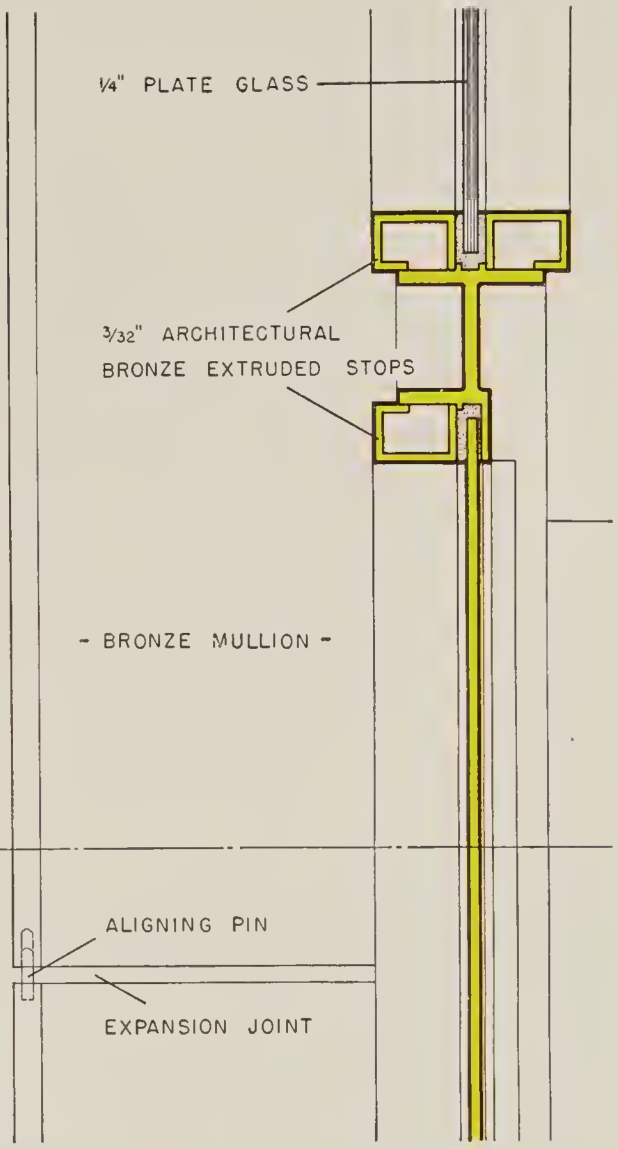


View of lower portion of Seagram Building showing main entrance and plaza.

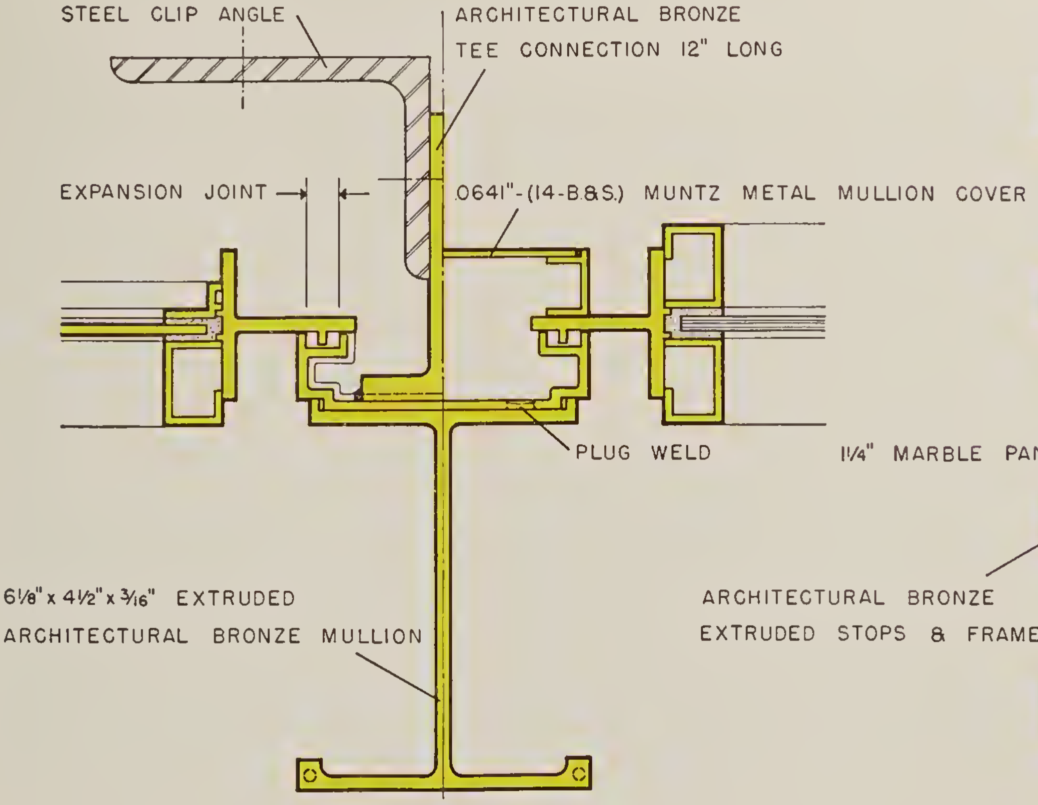
TYPICAL EXTERIOR WALL ELEVATION

SCALE ¼"=1'-0"

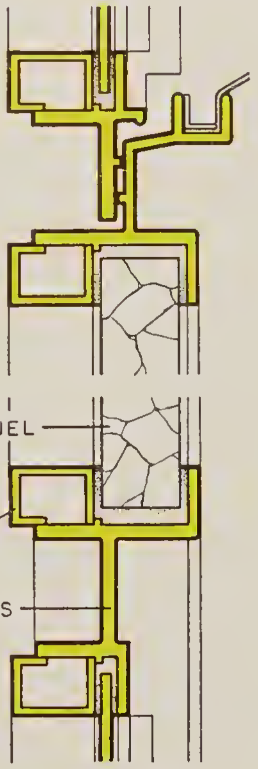


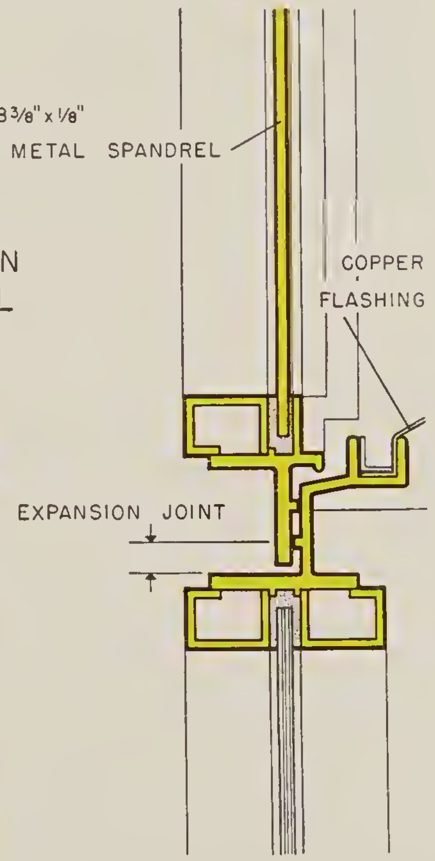


MULLION SECTION 1-1


STEEL CLIP ANGLE
ARCHITECTURAL BRONZE TEE CONNECTION 12" LONG
EXPANSION JOINT
.0641"-(14-B&S.) MUNTZ METAL MULLION COVER
PLUG WELD
6⅛" x 4½" x 3/16" EXTRUDED ARCHITECTURAL BRONZE MULLION

VERTICAL SECTION AT MARBLE PANEL



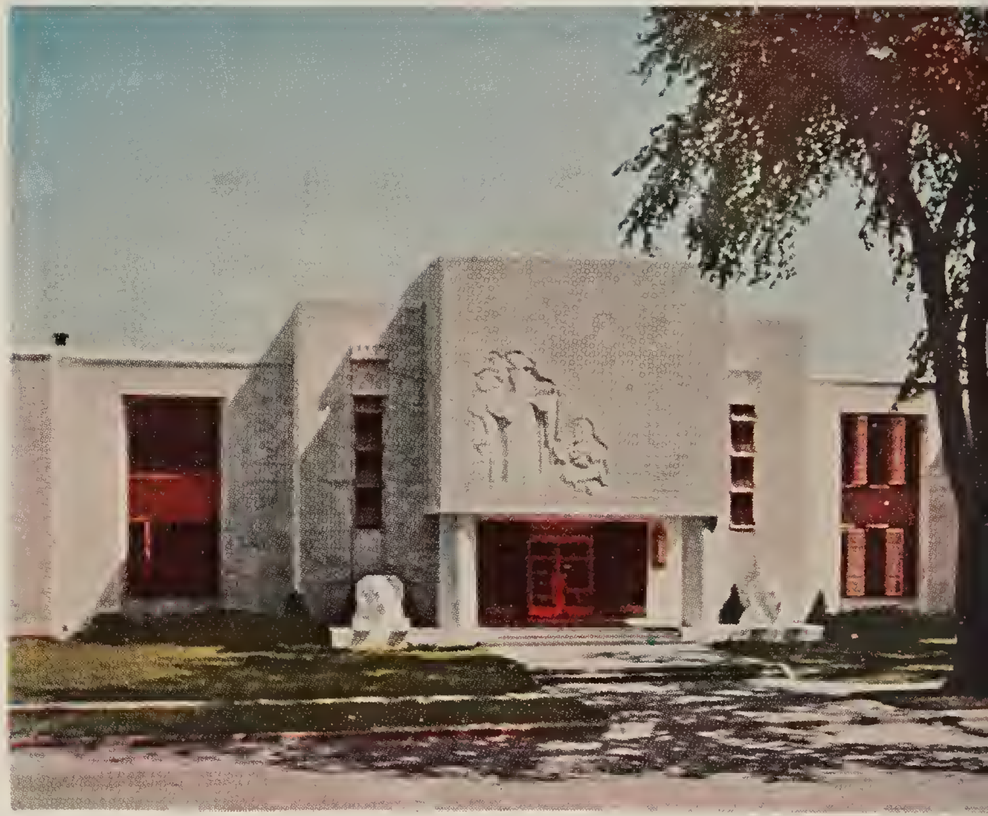


VERTICAL SPANDREL SECTION 2-2

SCALE 3"=1'-0"
UNLESS OTHERWISE NOTED

MASONIC LIBRARY, MUSEUM AND ADMINISTRATION BUILDING

CEDAR RAPIDS, IOWA

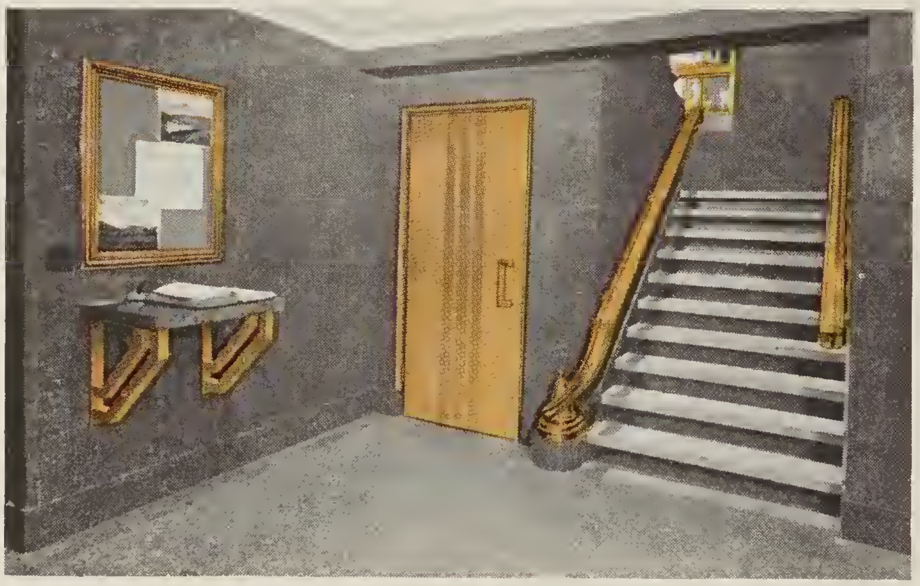


Freemasonry, like Bronze, dates back to ancient times. It is, therefore, wholly fitting that Bronze be used in the architecture of a Masonic building. The combination of Bronze and white marble is striking, and is equally good whether the metal is finished bright or antiqued.

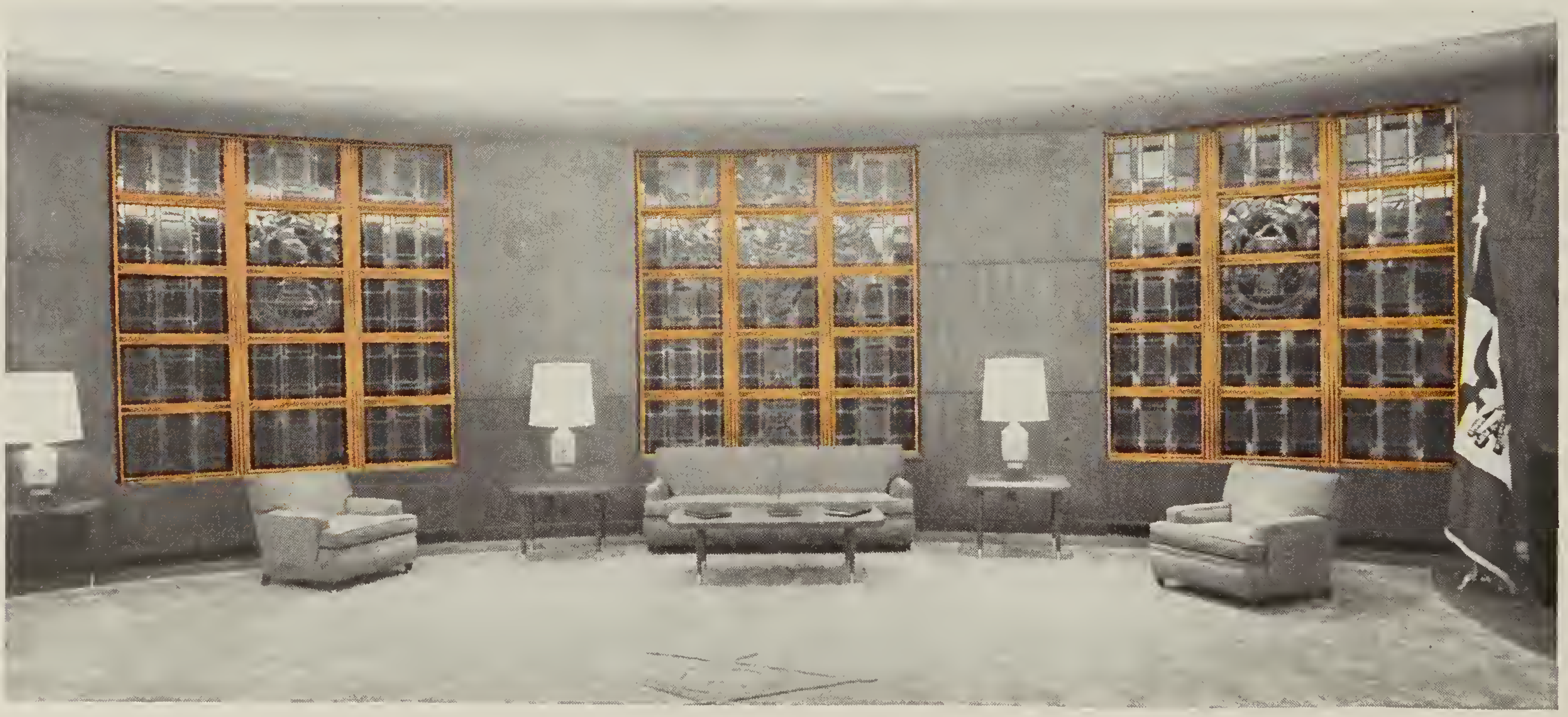
Waggoner & Waggoner, Architects
Mason City, Iowa

Fabricators:
Michaels Art Bronze Co., Inc.
Covington, Kentucky

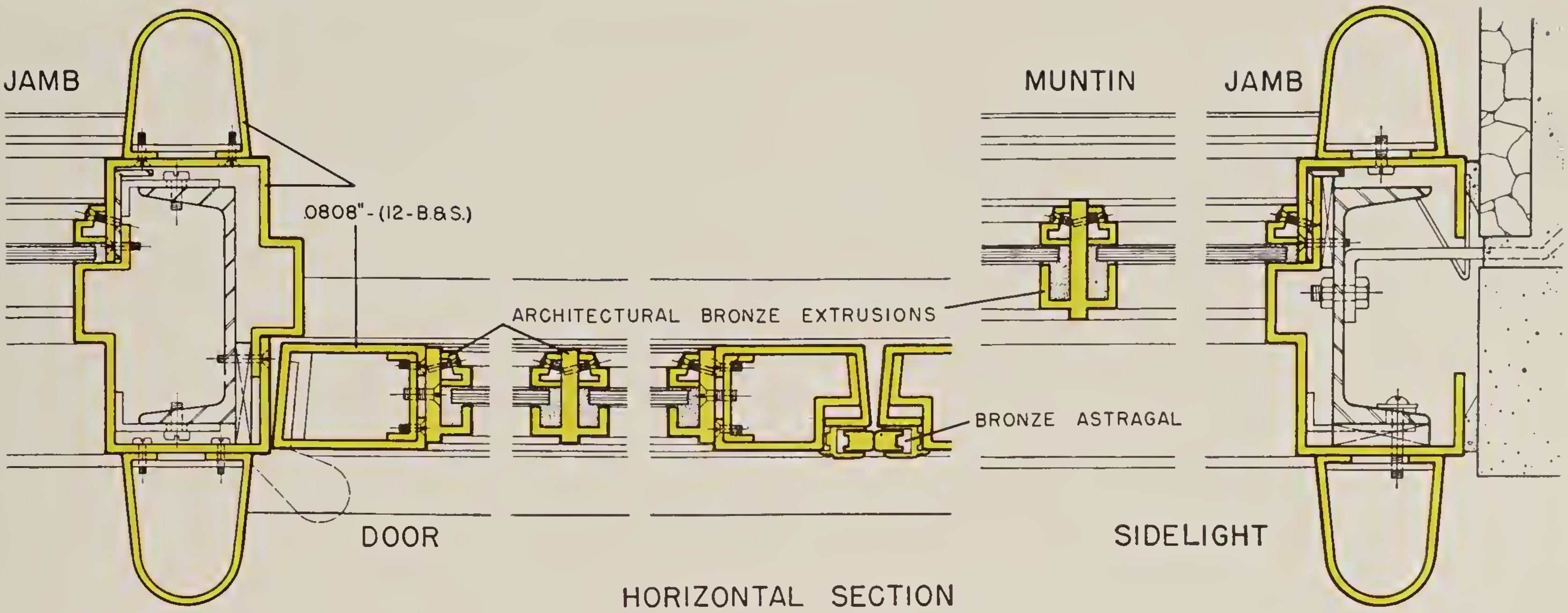
Universal Corporation (Windows)
Dallas, Texas



Foyer on the main floor, at left, illustrates the use of Architectural Bronze in public areas. Below are the Bronze-framed windows of the "War Memorial Room".

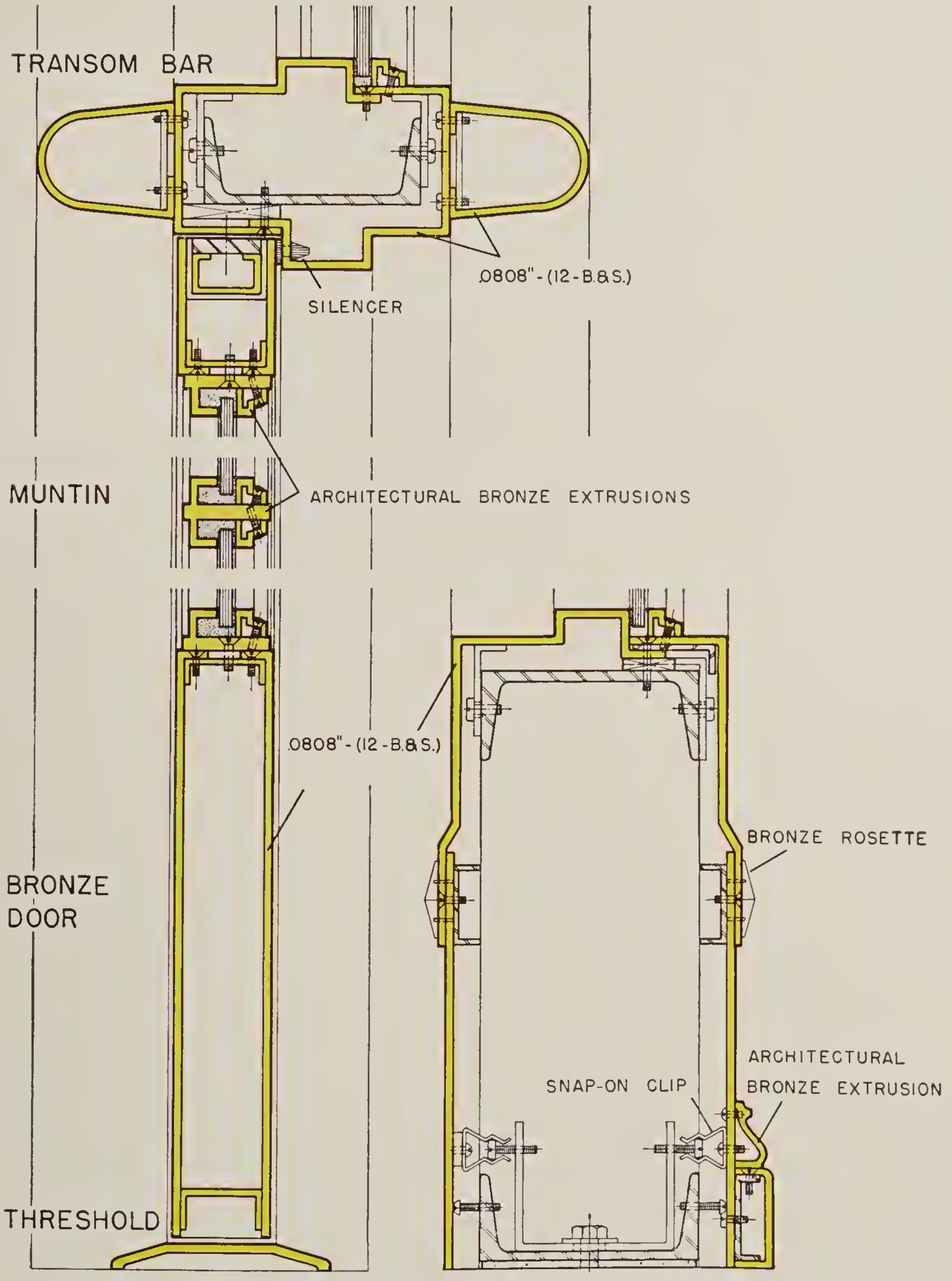


MASONIC LIBRARY AND ADMINISTRATION BUILDING



HORIZONTAL SECTION

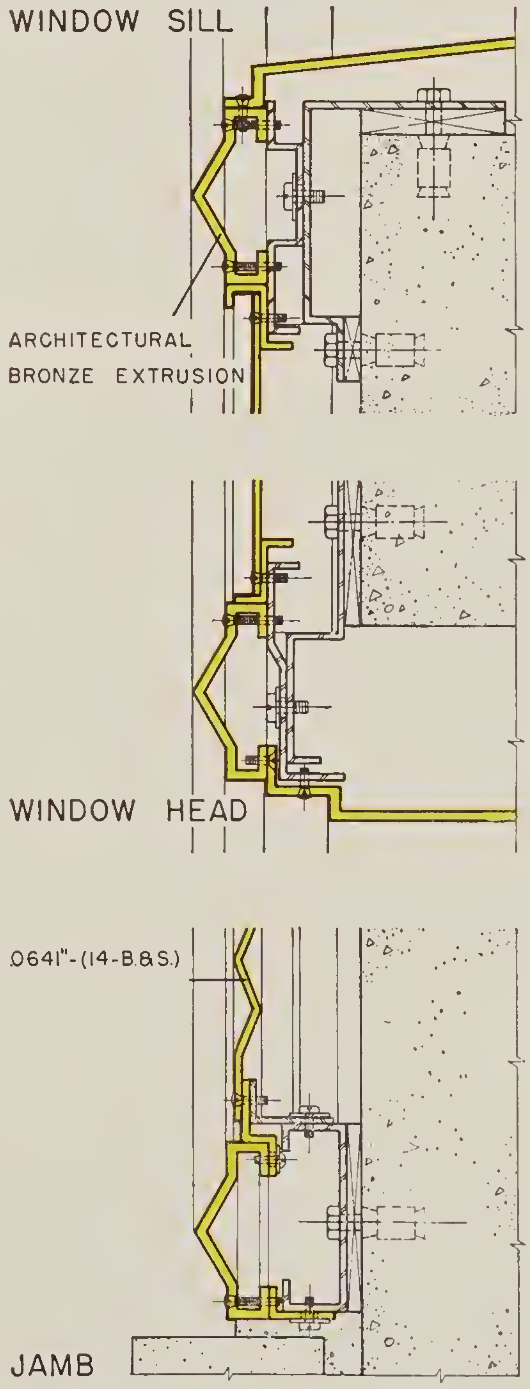
BRONZE ENTRANCE DOORS & FRAME



VERTICAL SECTION

SIDELIGHT BULKHEAD

BRONZE SPANDREL PANEL



ALL DETAILS SCALE 3" = 1'-0"

UNITED STATES NATIONAL BANK
DENVER, COLORADO

The architecture of this building is outstanding in its good design and use of architectural metals. The front entrance has cast Bronze doors with a stainless steel frame. The inner vestibule is done in aluminum. Details on Page 36.

The novel idea of facing the walls of the entry, the escalator and the circular columns in the banking area with heavy Bronze screening provides a beautiful and distinctive effect.

The spiral stairway with Red Brass railing is most attractive because of its good design and workmanship.

James S. Sudler, Architect
Denver, Colorado

Maria Bergson Associates,
Associated Interior Designers
New York, N. Y.

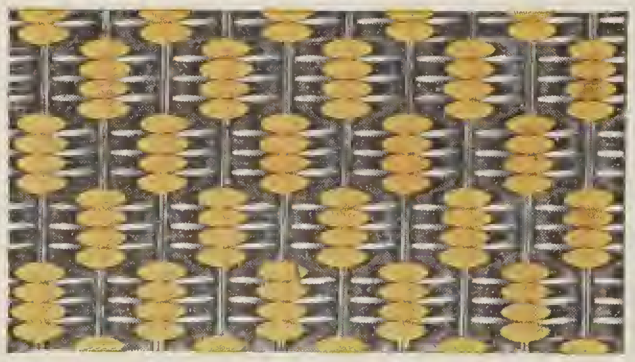
Edgar Britton, Sculptor (Bronze doors and outline map)
Colorado Springs, Colorado

Zimmerman Ornamental Bronze and Iron Works,
Fabricator
Denver, Colorado

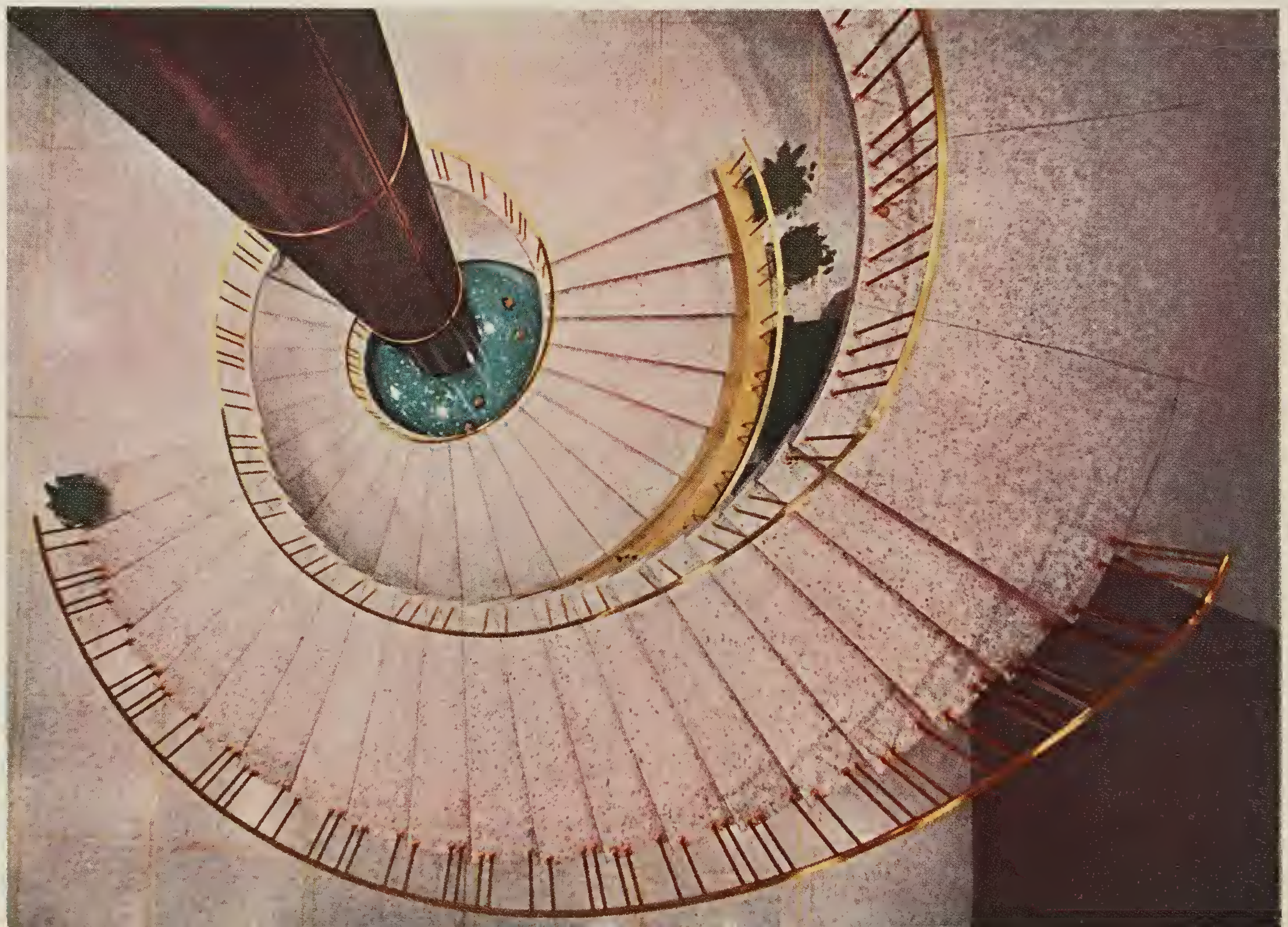
W. S. Tyler Company (Bronze mesh)
Cleveland, Ohio

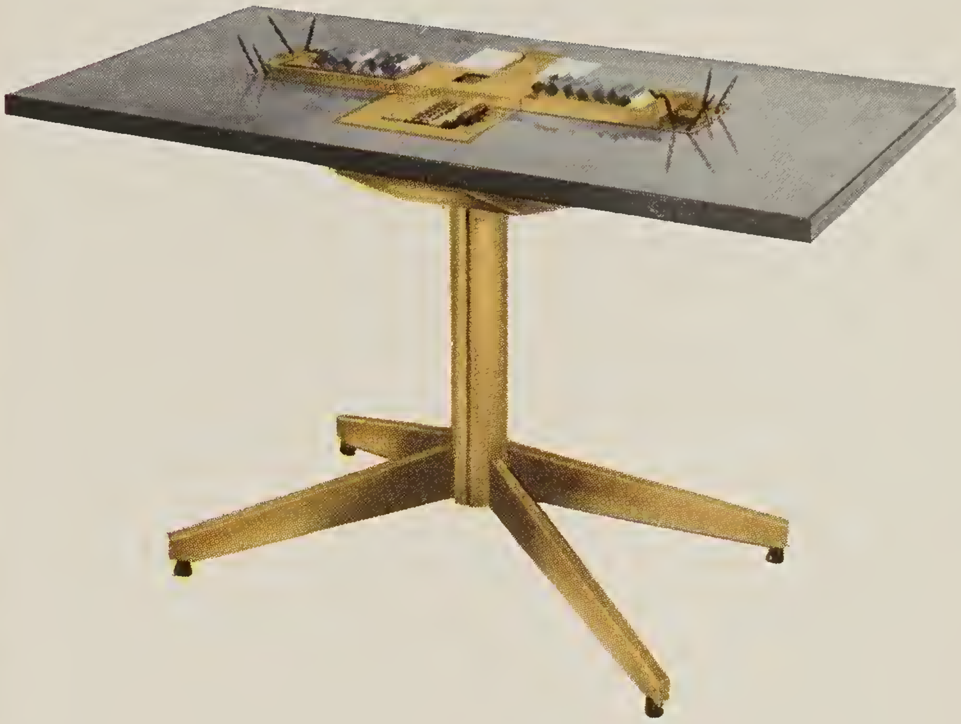
N. G. Petry Construction Co., General Contractors
Denver, Colorado

Decorative Bronze mesh for columns.

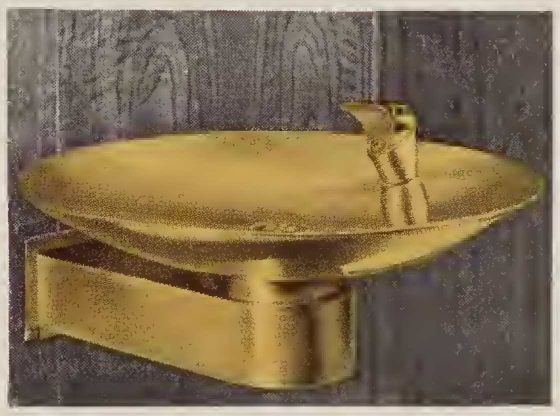


Graceful spiral stairway helps to integrate the several floor levels. Handrails are made of formed Red Brass strip, reinforced with rectangular Red Brass rod; the balusters are tubular Red Brass sleeves over round steel rod. The column is wrapped with woven Bronze wires that were partially colored to give an unusual black-and-gold effect.



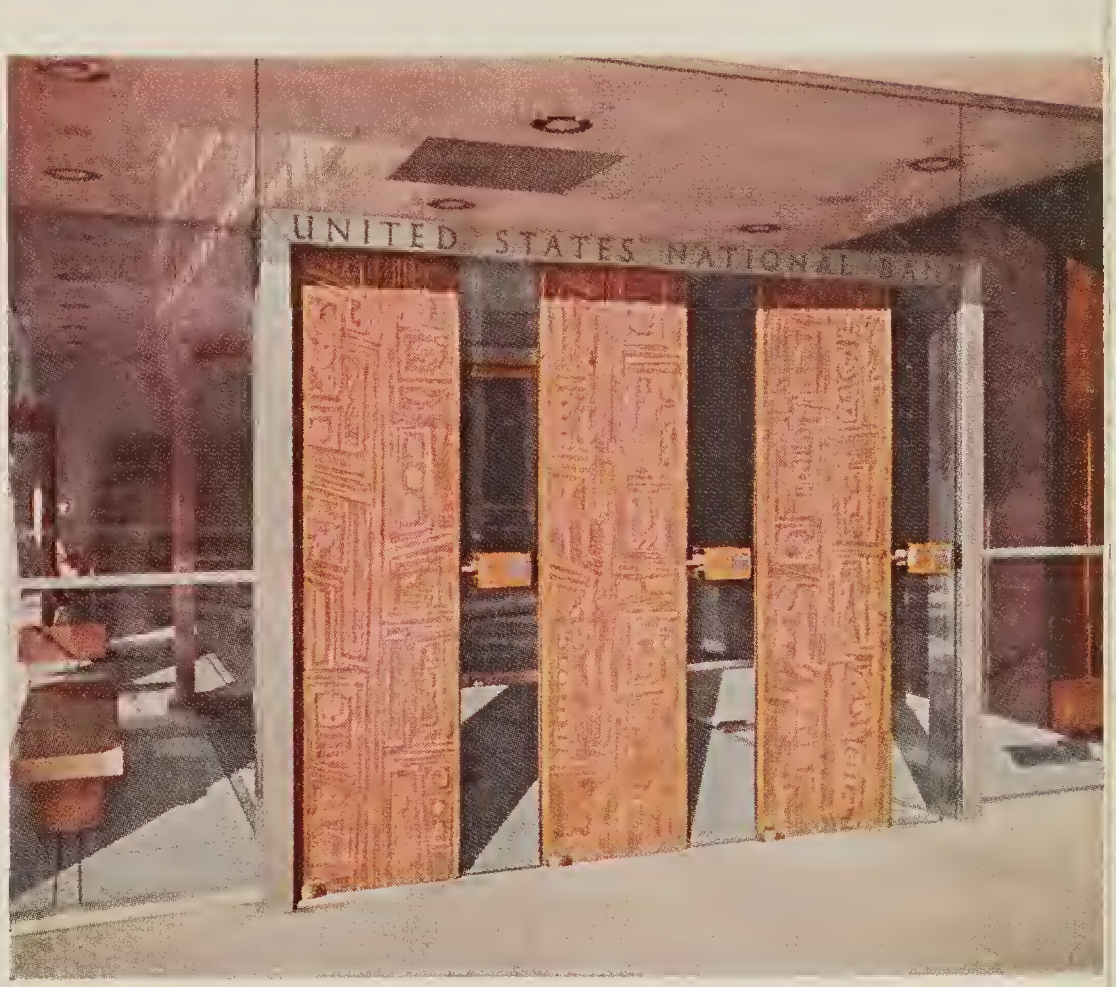


All the metal in the check desks on the two banking floors is Red Brass. The desks feature a flush, built-in adding machine.



An example of attention given to details is this drinking fountain of special design. The bowl is of Cast Bronze and is highly polished.

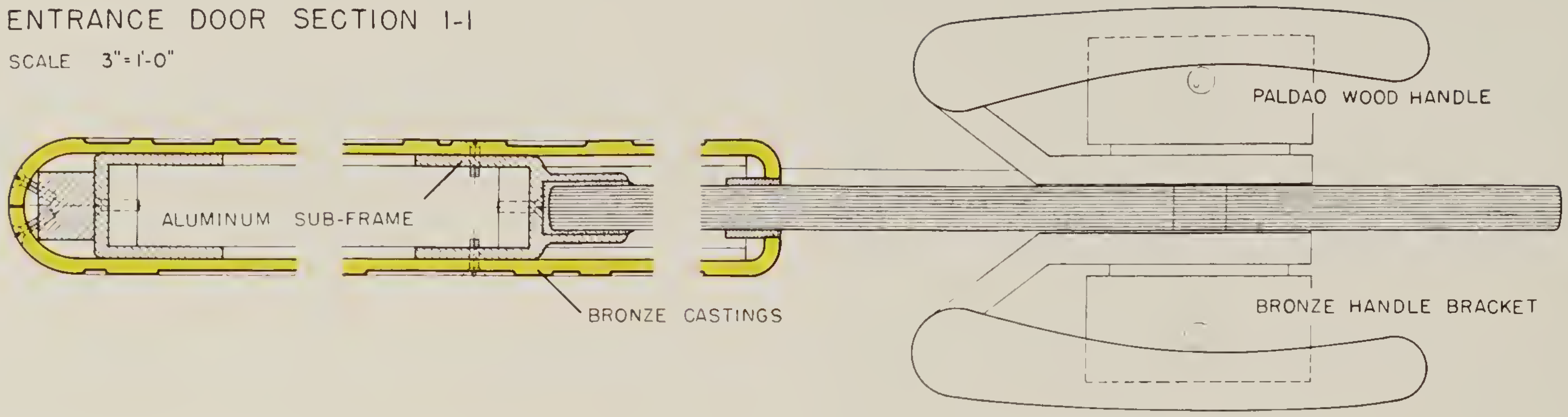
Main entrance of The United States National Bank on Broadway in Denver. The doors consist of tempered plate glass in combination with quarter-inch-thick Cast Bronze facings enriched with integral contemporary design.



UNITED STATES NATIONAL BANK

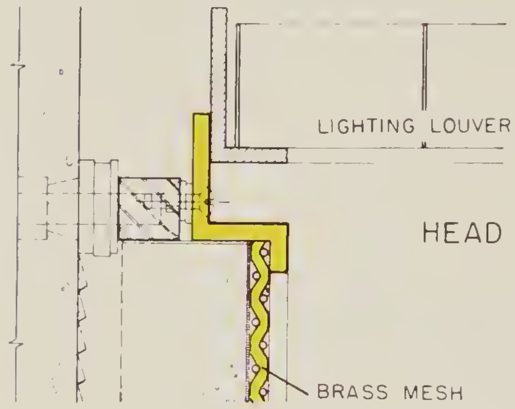
ENTRANCE DOOR SECTION 1-1

SCALE 3"=1'-0"

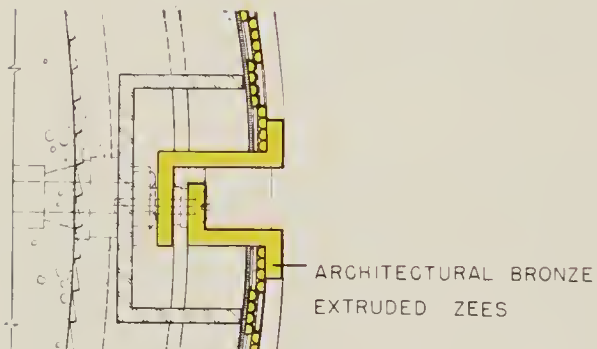


BRASS MESH COLUMN COVERING

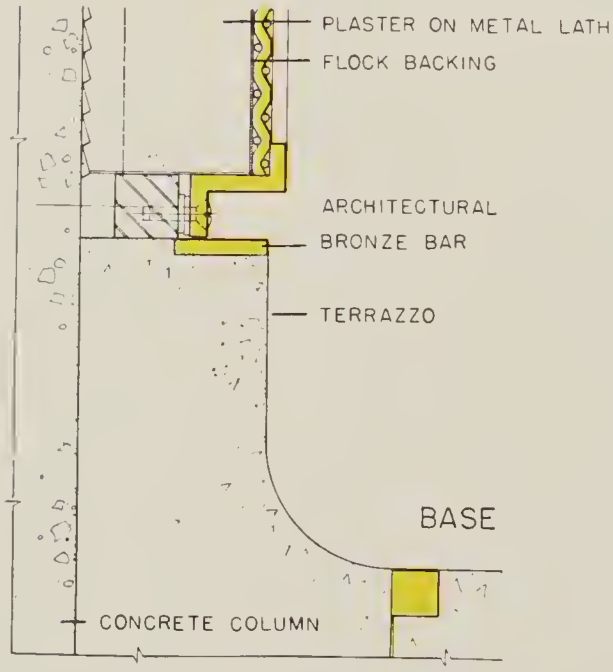
SCALE ½ FULL SIZE



HEAD



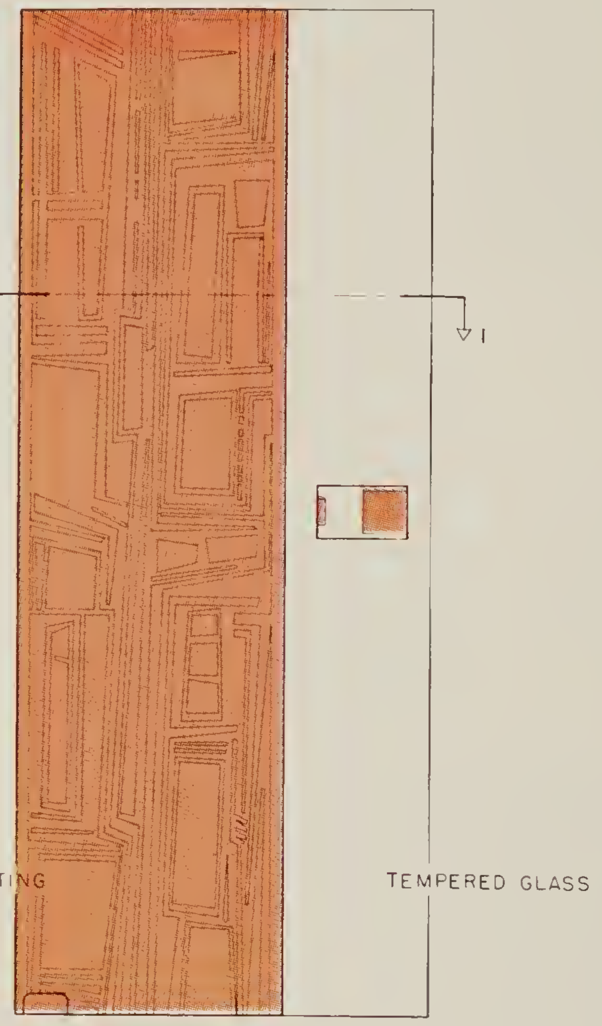
VERTICAL JOINT

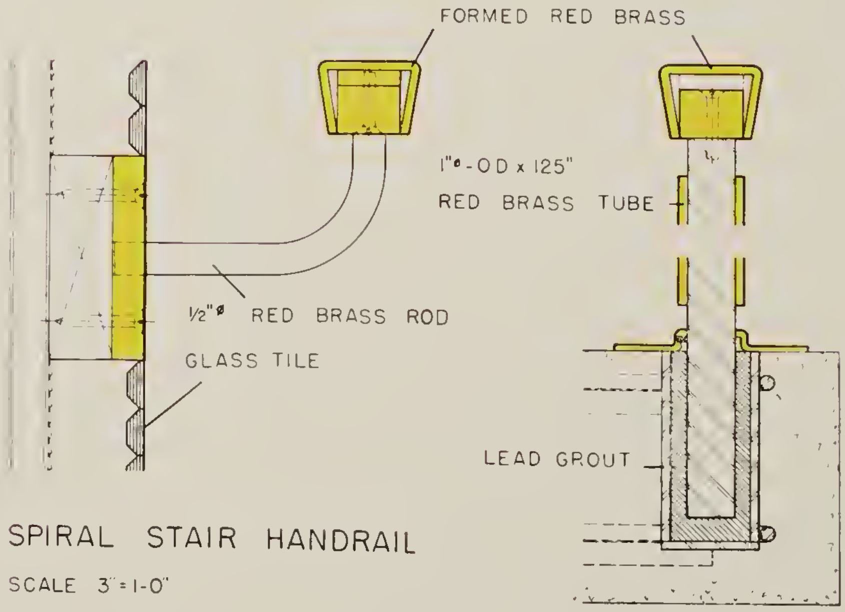


BASE

ENTRANCE DOOR

SCALE ½"=1'-0"





SPIRAL STAIR HANDRAIL

SCALE 3"=1'-0"

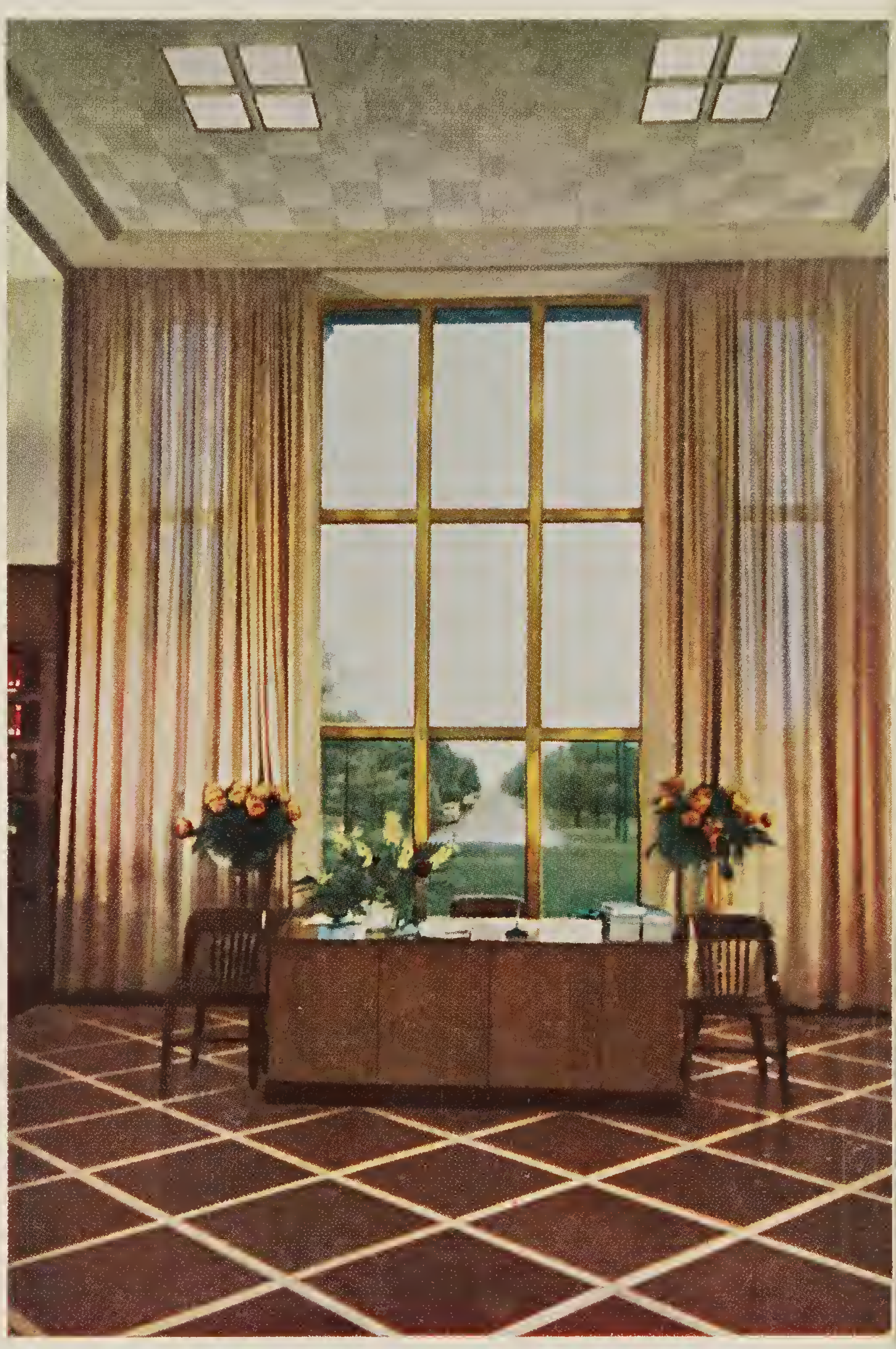
SAM RAYBURN LIBRARY
BONHAM, TEXAS

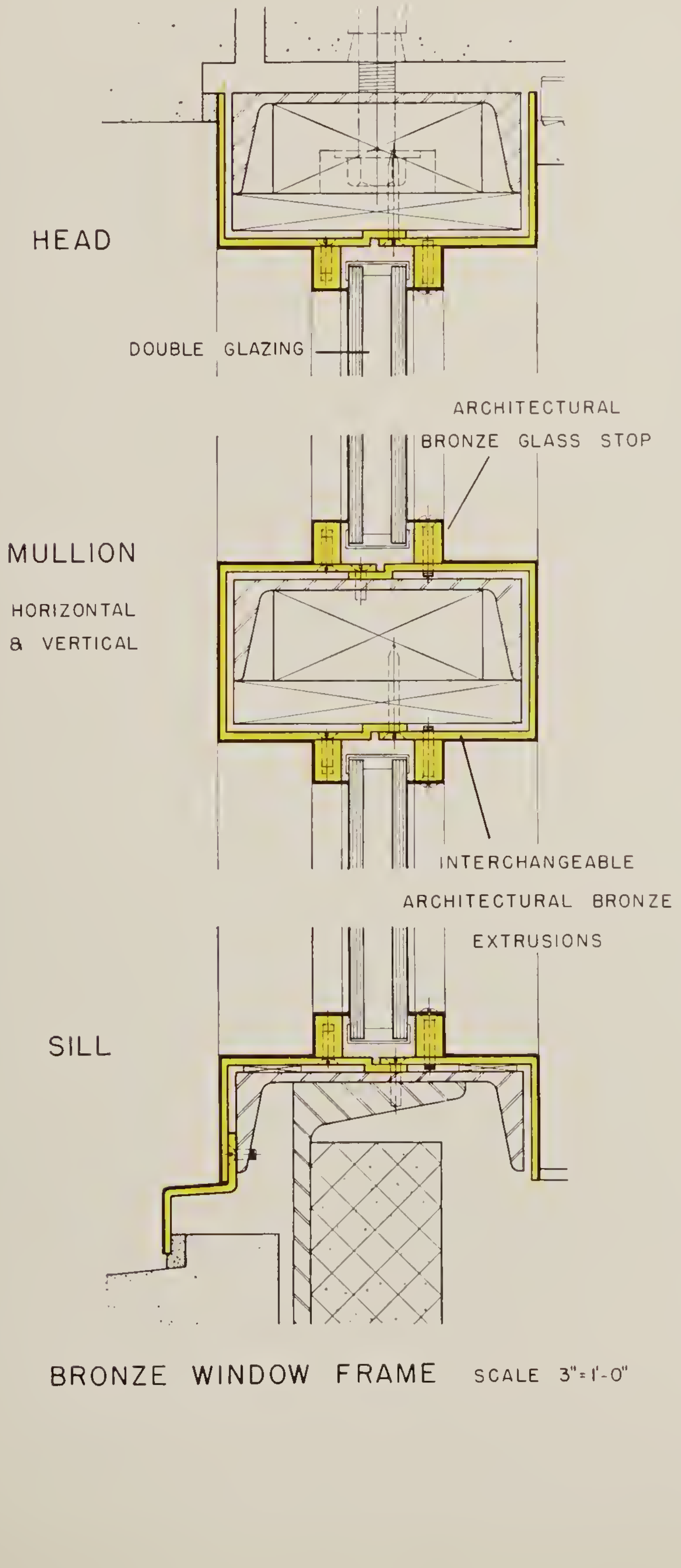
The stately Bronze window in the east wall of the library is a picture of simplicity. Its style and quality possess a dignity that is well in keeping with the architecture of the building.

The clear, double glazing insures comfort at the inside of the window, in both summer and winter.

Roscoe Dewitt, Architect
Dallas, Texas

Dallas Metalsmith, Fabricator
Dallas, Texas




HEAD
DOUBLE GLAZING
ARCHITECTURAL BRONZE GLASS STOP
MULLION
HORIZONTAL & VERTICAL
INTERCHANGEABLE ARCHITECTURAL BRONZE EXTRUSIONS
SILL

BRONZE WINDOW FRAME SCALE 3"=1'-0"

LONGWOOD GARDENS
KENNETT SQUARE, PENNSYLVANIA

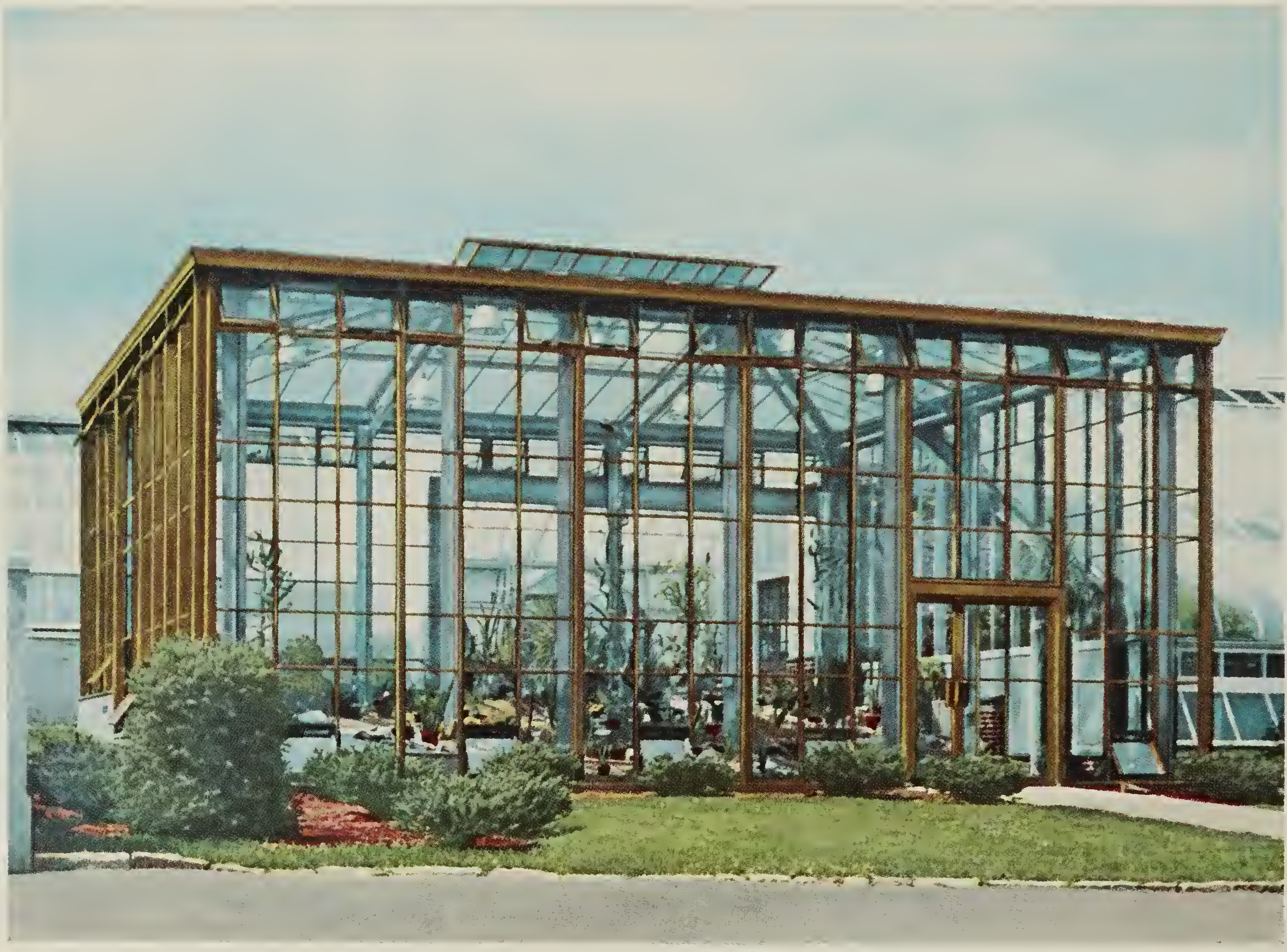
This new and modern concept of horticultural-building design makes use of Bronze and glass for the exterior walls. The Bronze is particularly able to endure the humidity and condensation that is common in buildings in which plants are grown. The oxidized finish on Bronze, as at Longwood Gardens, is in harmony with the nature of plant life and the metal on the interior will acquire a beautiful variegated coloration.

The full richness and stability embodied in the design were obtained by using stock angles, bars and tubular sections. This work is an excellent example of the economy and beauty that is possible through the use of standard shapes. Only a few special shapes were needed to complete the design.

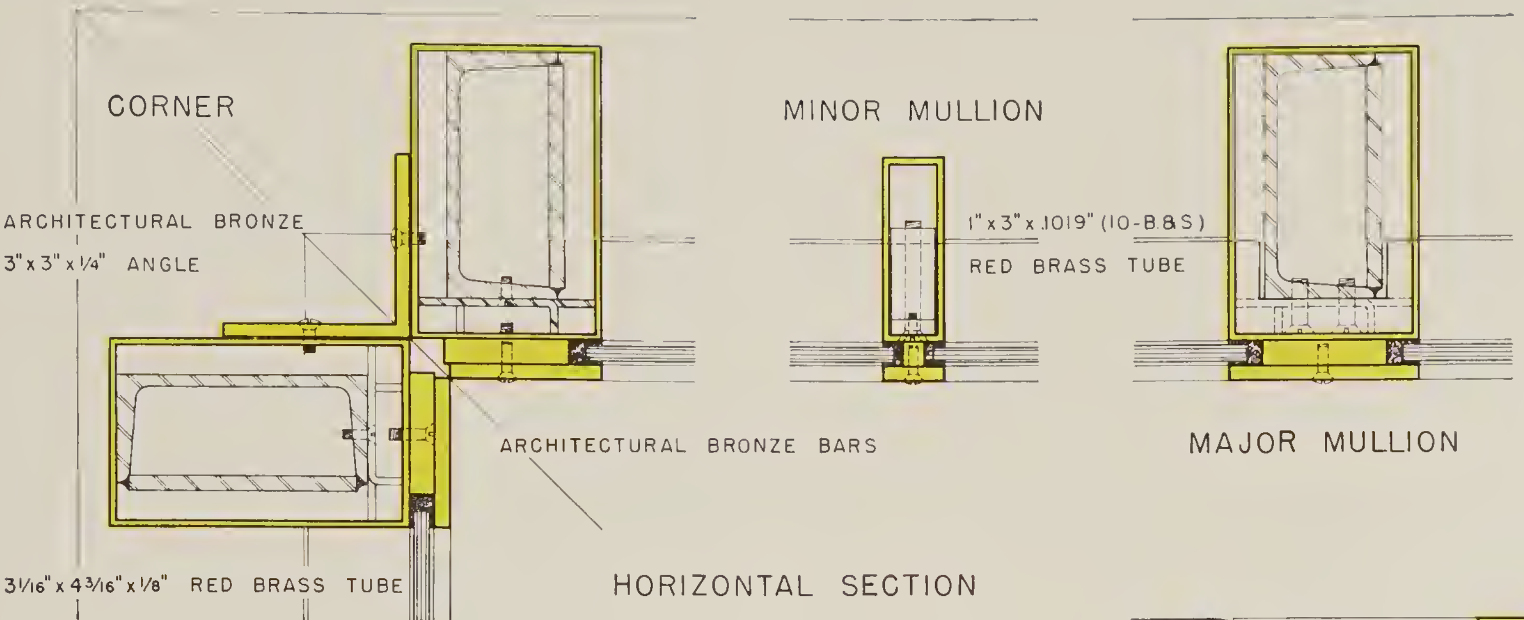
Victorine & Samuel Homsey, Architects
Wilmington, Delaware

Modern Metal Crafts Company, Fabricator
Philadelphia, Pennsylvania

J. S. Cornell & Son, General Contractor
Philadelphia, Pennsylvania



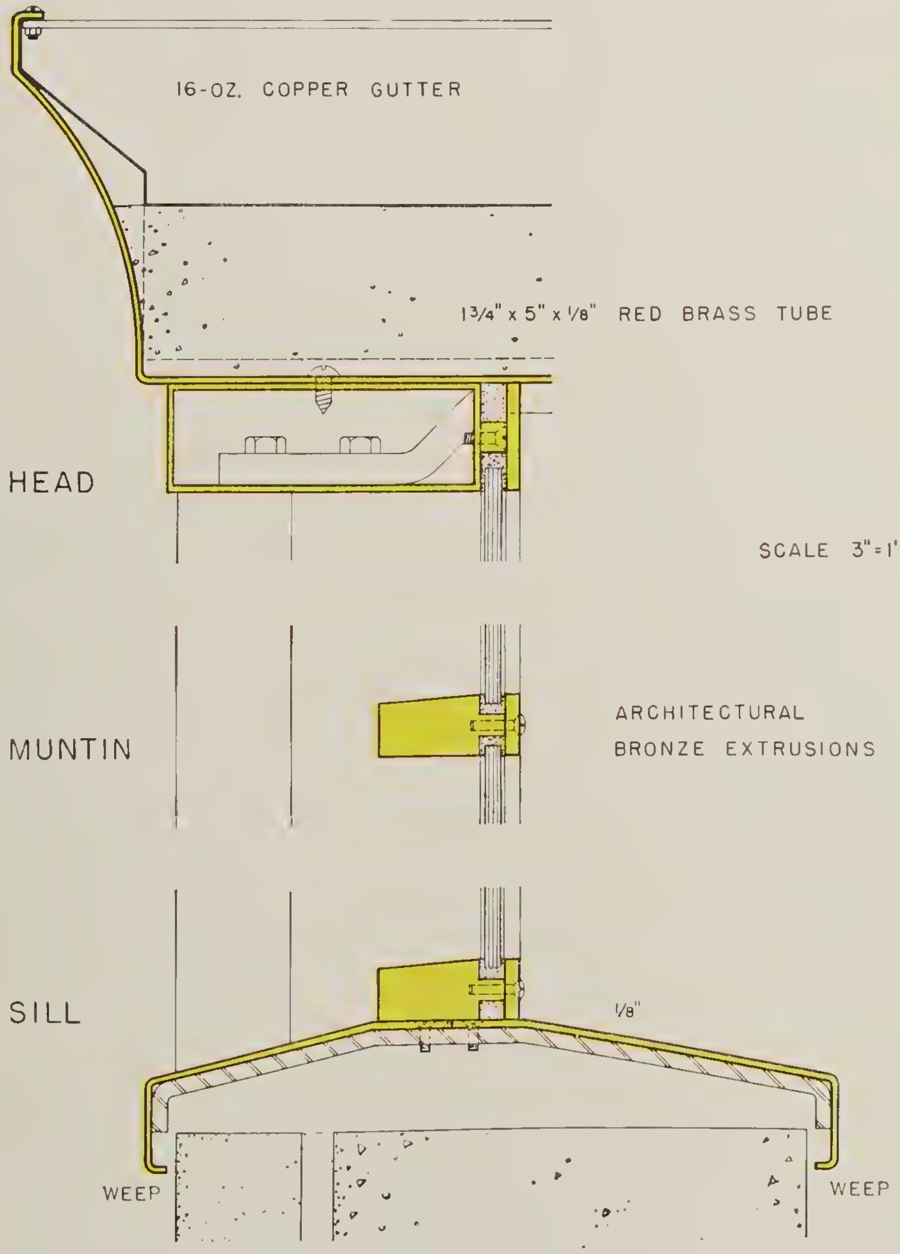
LONGWOOD GARDENS



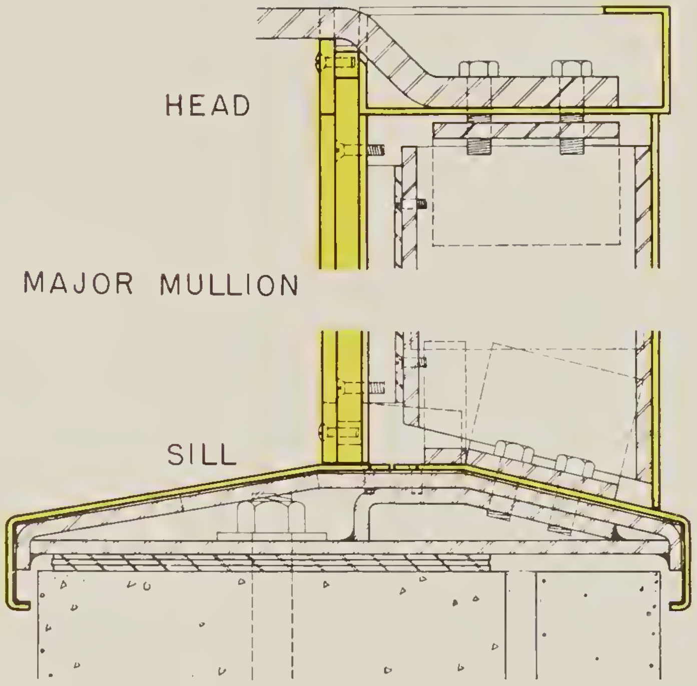
HORIZONTAL SECTION

WINDOW WALL DETAILS

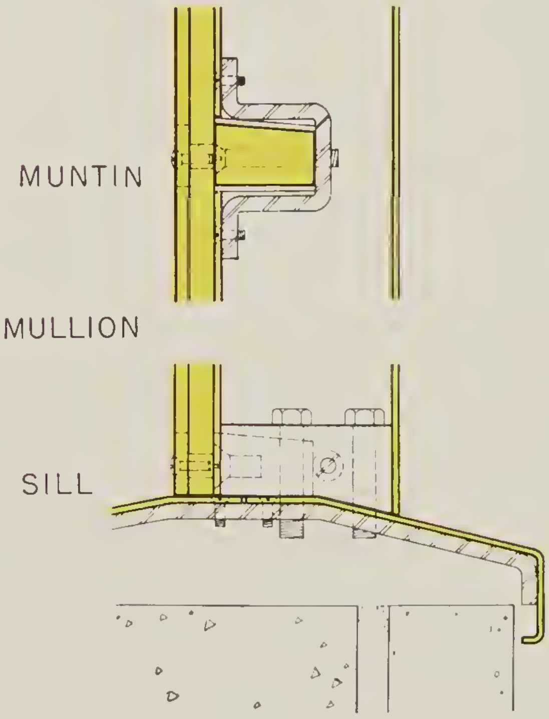
VERTICAL SECTION



SCALE 3"=1'-0"



FASTENING DETAILS



LAND TITLE BUILDING
PHILADELPHIA, PENNSYLVANIA

The entrance and lobby of this building have been renovated and modernized in the new architecture. The abundantly molded and decorated walls and columns of artificial marble (scagliola) were replaced with tastefully proportioned, plain surfaces of polished granite, marble and Extruded Architectural Bronze.

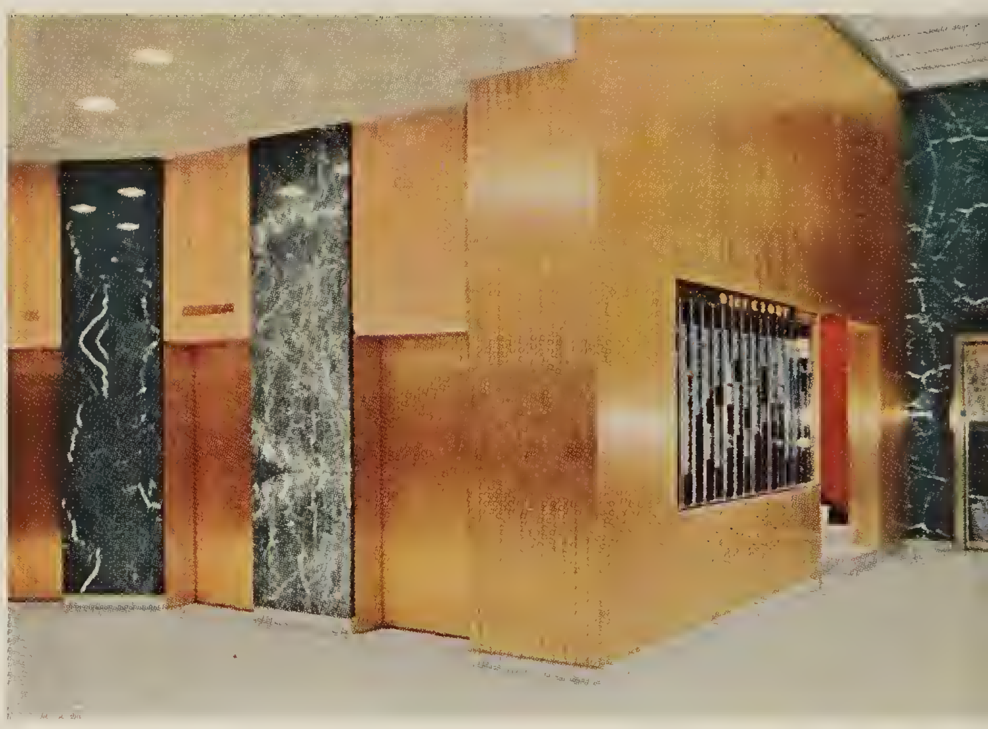
The straight bands of reflected light across the Bronze wall facing are proof of the best quality of material and workmanship. The extruded metal has sufficient stiffness to permit easy cleaning, and can be finished and refinished indefinitely without losing the original color and quality.

Thalheimer and Weitz, Architects
Philadelphia, Pennsylvania

John G. Leise Metal Works, Fabricator
Philadelphia, Pennsylvania

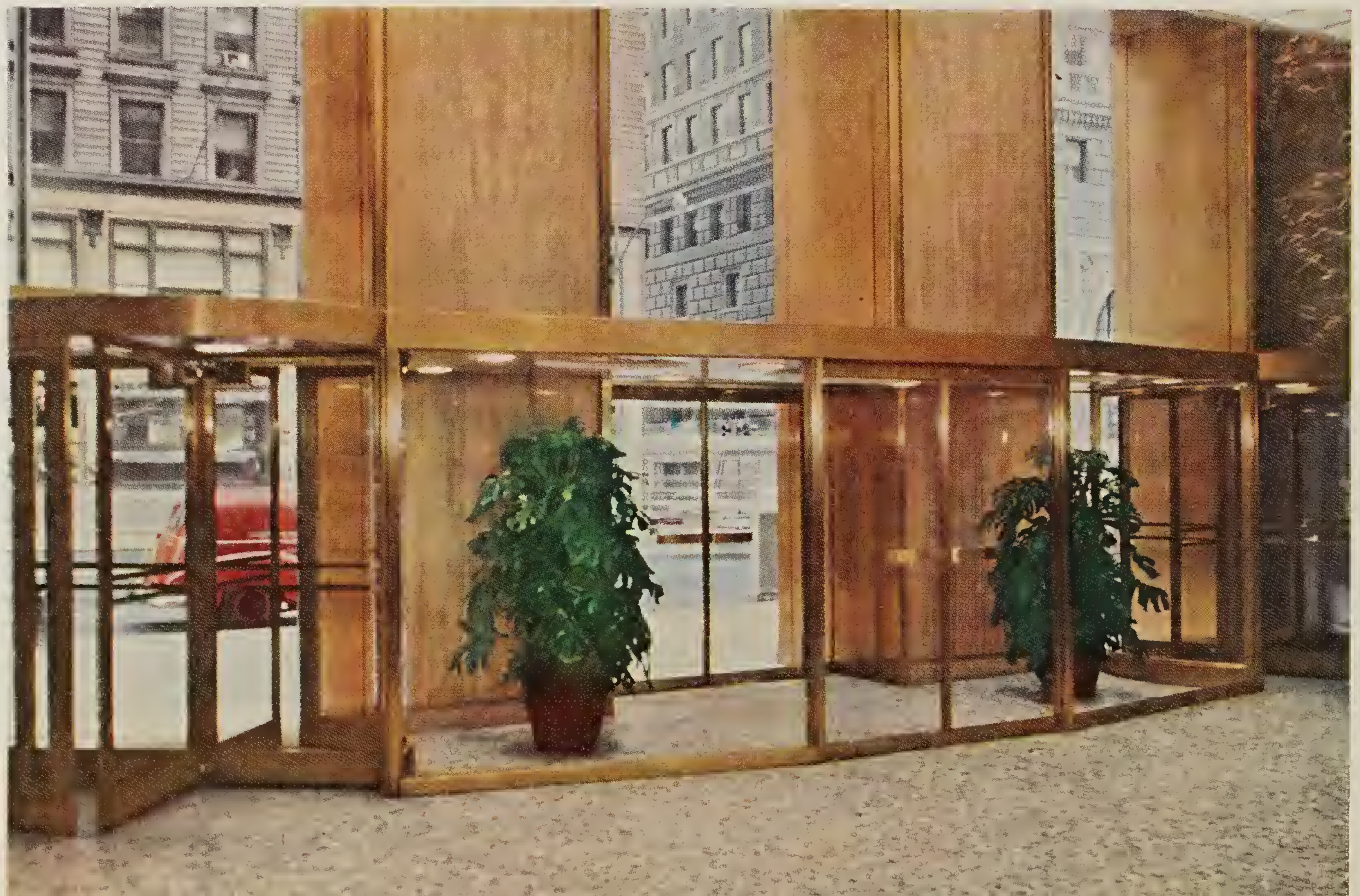
W. S. Tyler Company (Elevator entrances)
Cleveland, Ohio

Revolving Door and Entrance Division,
International Steel Company (Exterior doors)
Evansville, Indiana

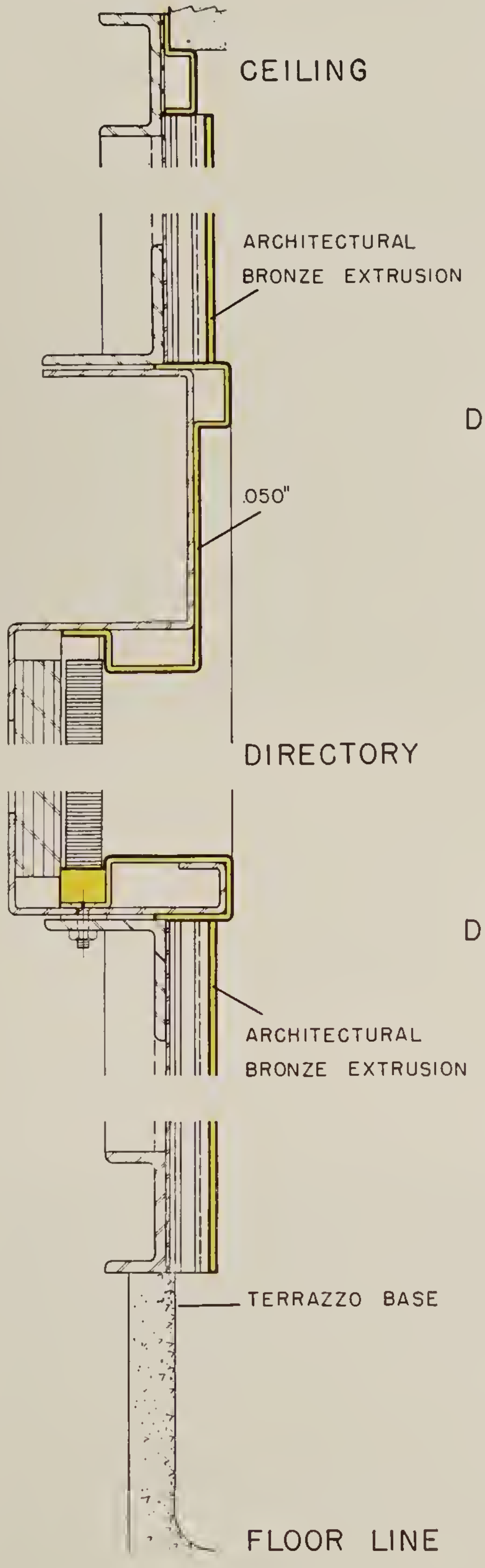


Interlocking Bronze extrusions with 3-inch exposed surfaces form smart, trim panels from floor to ceiling in the main lobby.

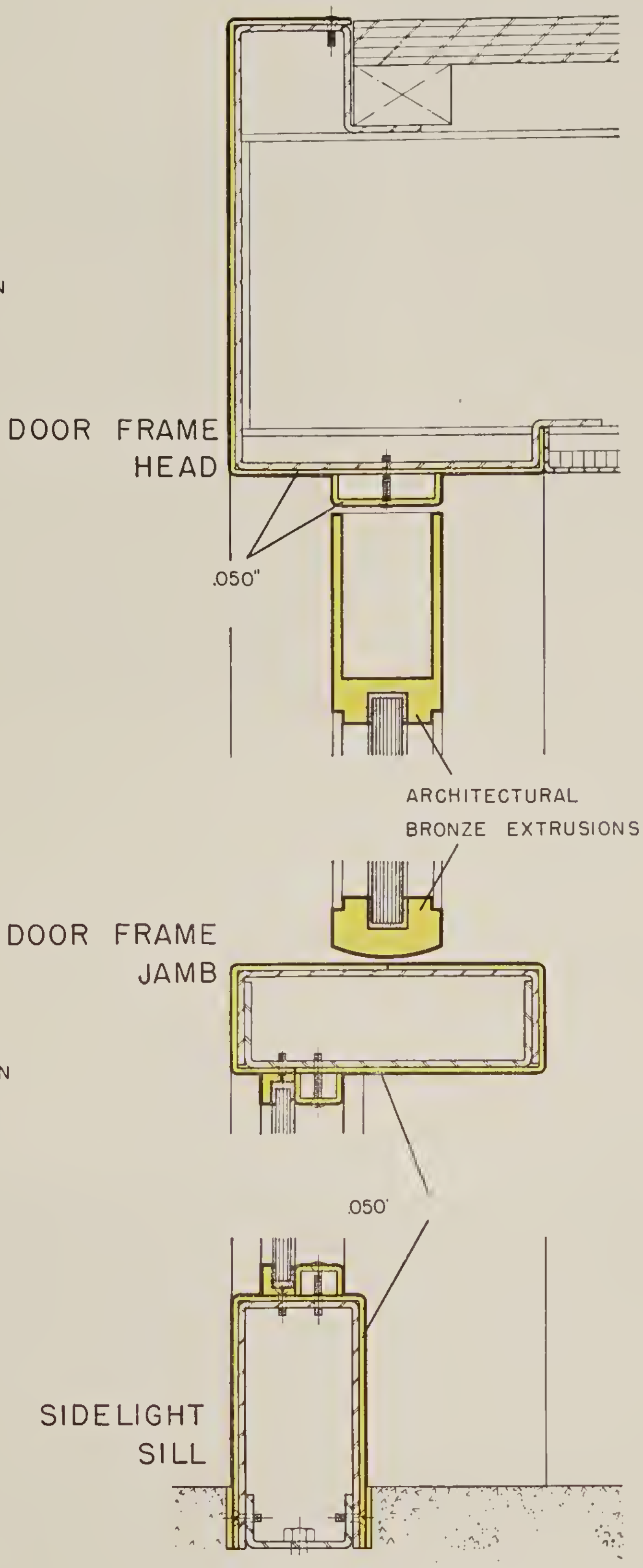
The Bronze sheet and strip which frame vestibules and door openings have a warm, golden color to complement the tans and browns of the floor and marble veneer.



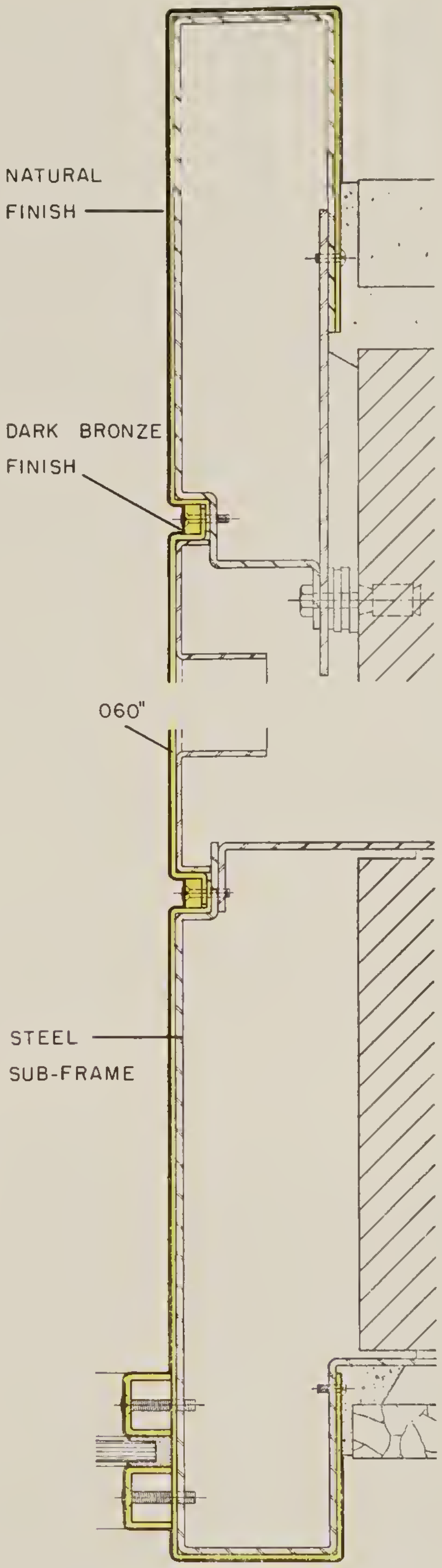
LAND TITLE BUILDING


CEILING
ARCHITECTURAL BRONZE EXTRUSION
.050"
DIRECTORY
ARCHITECTURAL BRONZE EXTRUSION
TERRAZZO BASE
FLOOR LINE

VERTICAL SECTION



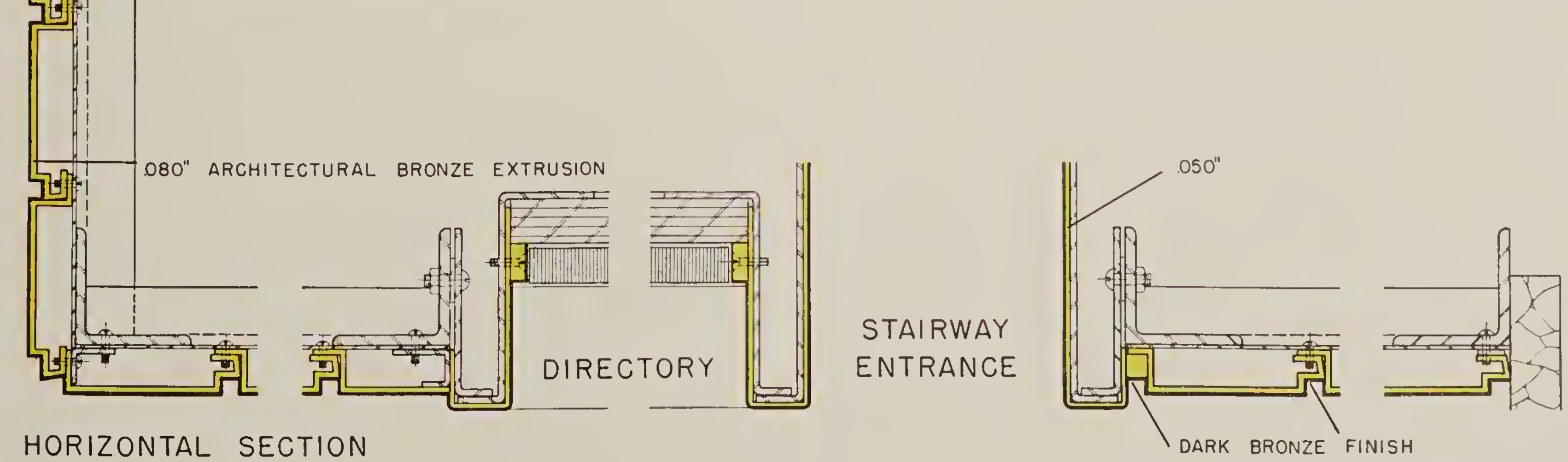
BRONZE VESTIBULE DOORS & FRAME



BRONZE ENTRANCE PANELING TRANSOM JAMB SECTION

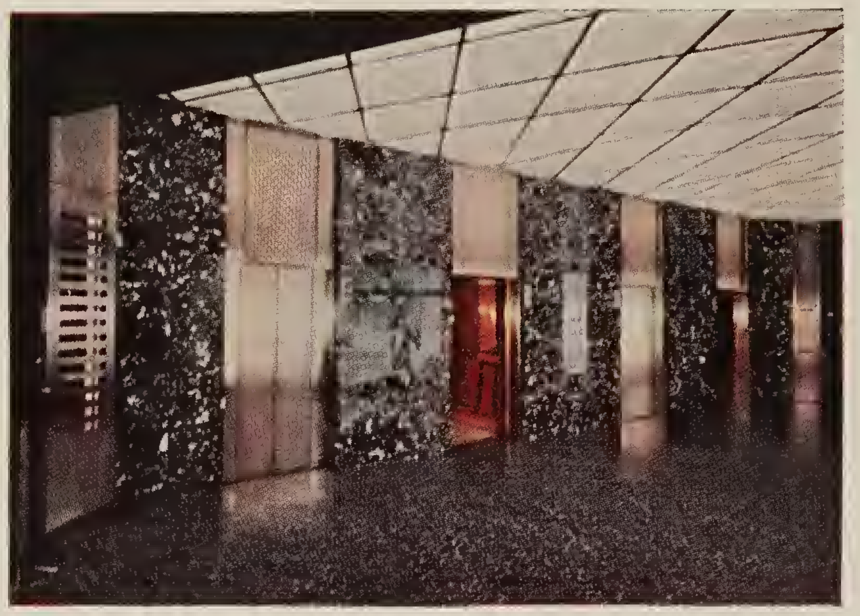
DIRECTORY WALL DETAILS

ALL DETAILS SCALE 3"=1'-0"



HORIZONTAL SECTION

550 SOUTH FLOWER BUILDING
LOS ANGELES, CALIFORNIA



Color in the architecture of this building is largely a matter of tints. The principal theme is white metal, white marble and polished black granite on the exterior, and a combination of Nickel Silver and Architectural Bronze in a setting of figured, black-and-white marble on the interior.

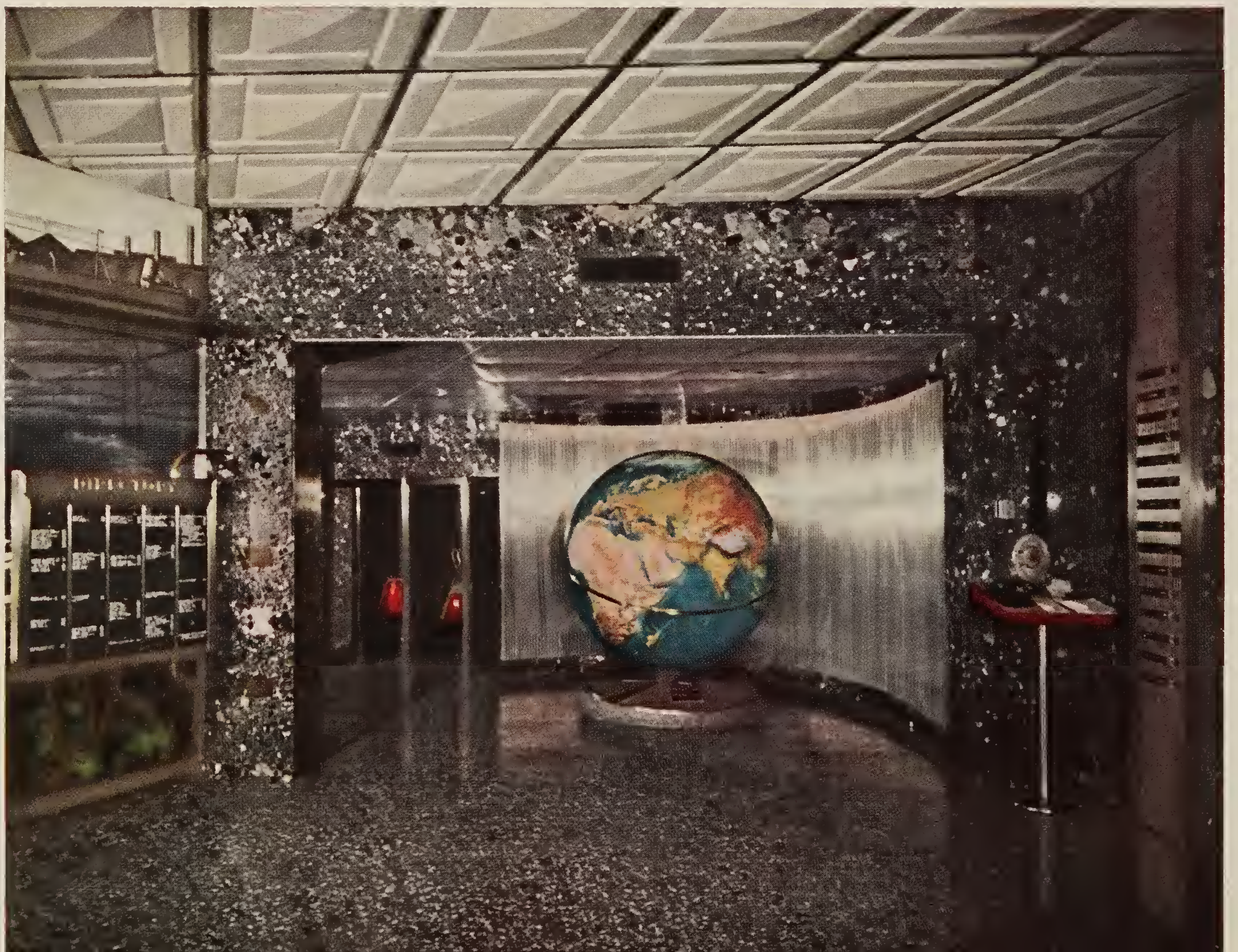
The lobby has ceiling-height wainscoting of 13% Extruded Nickel Silver. Elevator fronts and the grid for the luminous ceiling are also of Nickel Silver with touches of Bronze.

This modern architecture, in white, with diffused over-all lighting from the ceiling and the opalescent reflection of light from the Nickel Silver, is an example of the pleasing artistic effects possible through imaginative design.

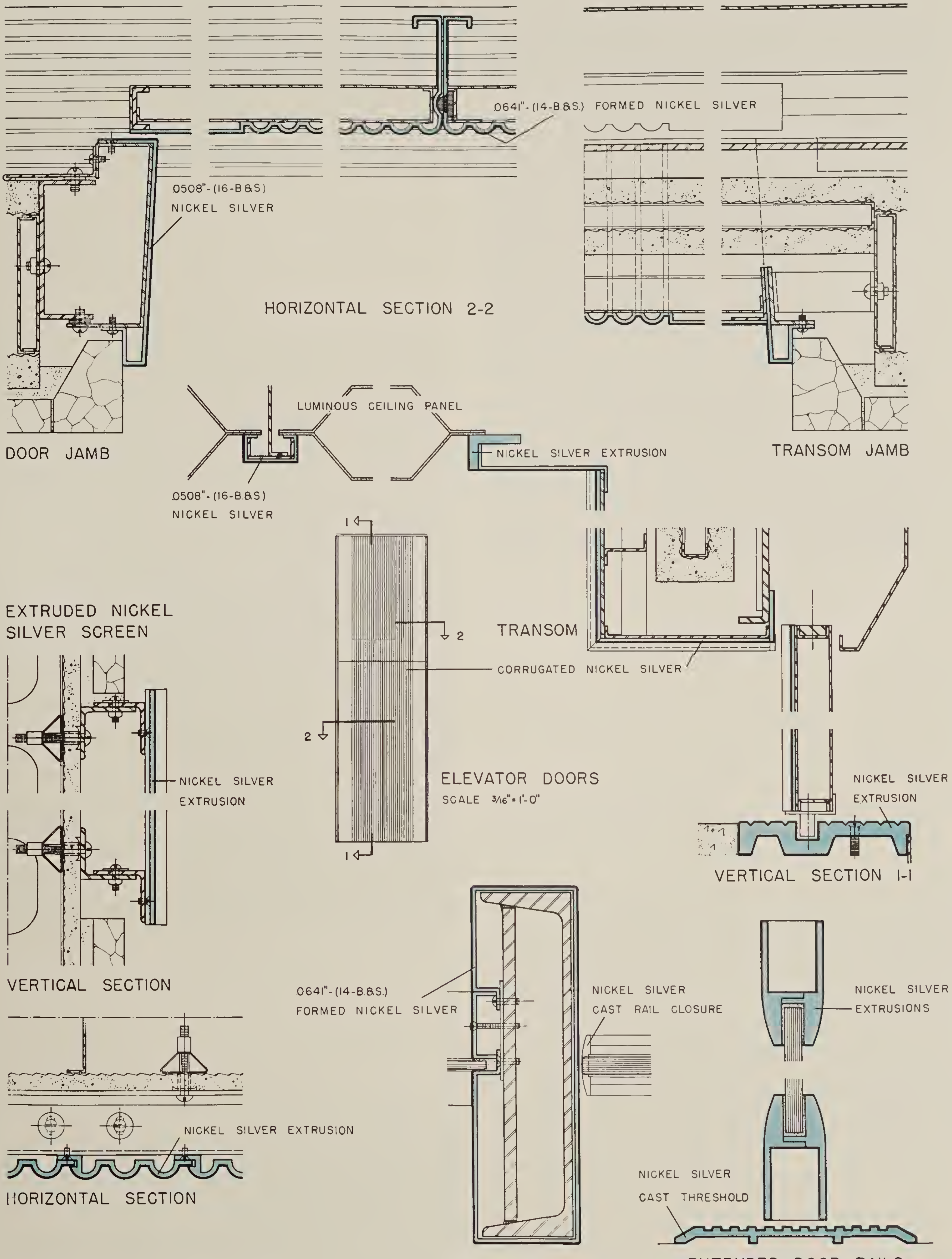
Claud Beelman & Associates, Architects
Los Angeles, California

Fabricators: Cochran-Izant & Co.
Los Angeles, California

A. J. Bayer Company (Elevators)
Los Angeles, California



550 SOUTH FLOWER BUILDING



DOOR JAMB

HORIZONTAL SECTION 2-2

TRANSOM JAMB

TRANSOM

ELEVATOR DOORS
SCALE 3/16"=1'-0"

EXTRUDED NICKEL SILVER SCREEN

VERTICAL SECTION

HORIZONTAL SECTION

VERTICAL SECTION 1-1

DOOR FRAME JAMB

EXTRUDED DOOR RAILS

SCALE 3"=1'-0" UNLESS OTHERWISE NOTED

TERMINAL BUILDING
LAMBERT-ST. LOUIS MUNICIPAL AIRPORT
ST. LOUIS, MISSOURI

The fact that the roof is an important part of the architecture of a building is demonstrated by the St. Louis Airport.

The Copper roof of batten-seam construction, using battens of proper size and spacing, offers a pleasing texture and is also the most trouble-free construction that has yet been devised. This type of roof requires no solder and every seam is, in effect, an expansion joint.

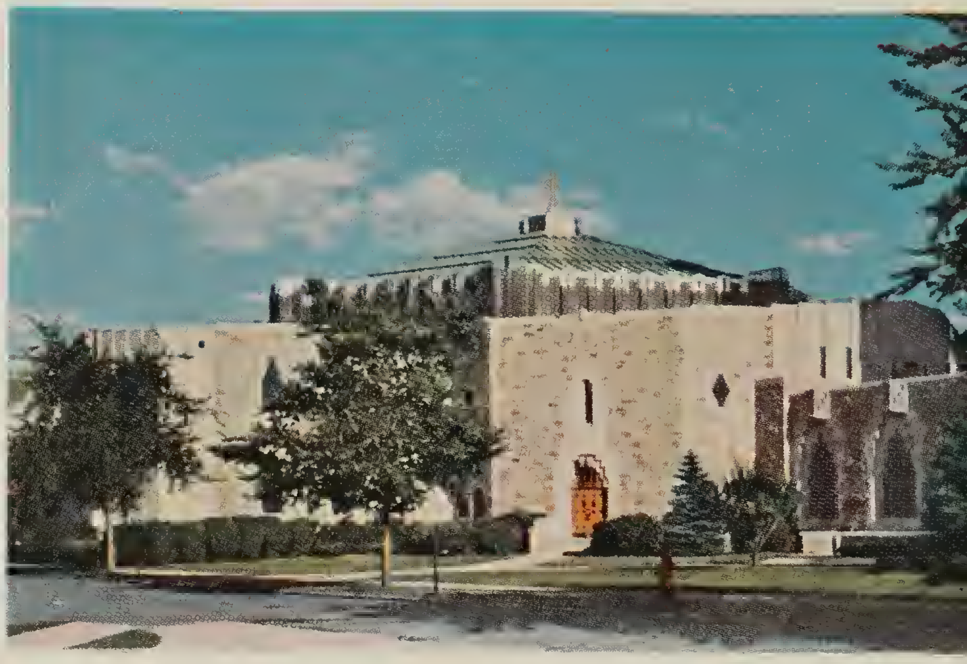
Leinweber, Yamasaki & Hellmuth, Architects
Detroit, Michigan

Mound Rose Cornice and Sheet Metal Works,
Sheet Metal Contractor
St. Louis, Missouri

SHRINE OF THE LITTLE FLOWER
ROYAL OAK, MICHIGAN

The roof on this building is original in several respects. It covers a Hall of Worship, more or less circular in form, which is a forerunner of the more recent churches built in the modern concept. It is of special interest because the roofing is of Red Brass instead of the usual Copper. The architects wanted the distinctive color of Red Brass, both new and weathered, and the stiffness and trim appearance that goes with this metal.

In about twelve years the Red Brass developed a surface coloring or patina that is pleasingly artistic. It is not a uniform, vivid green patina as it would be on pure Copper, but a sky-blue green with deep shadows of greenish gray, resulting in a very beautiful effect.



Henry J. McGill & Talbot Hamlin, Architects

Sullivan & Bernhagen, Sheet Metal Contractor
Detroit, Michigan

HAMMERED COPPER HOOD

A hood like this one of 48-ounce Copper with a light temper can be constructed so as to be either functional or purely ornamental.

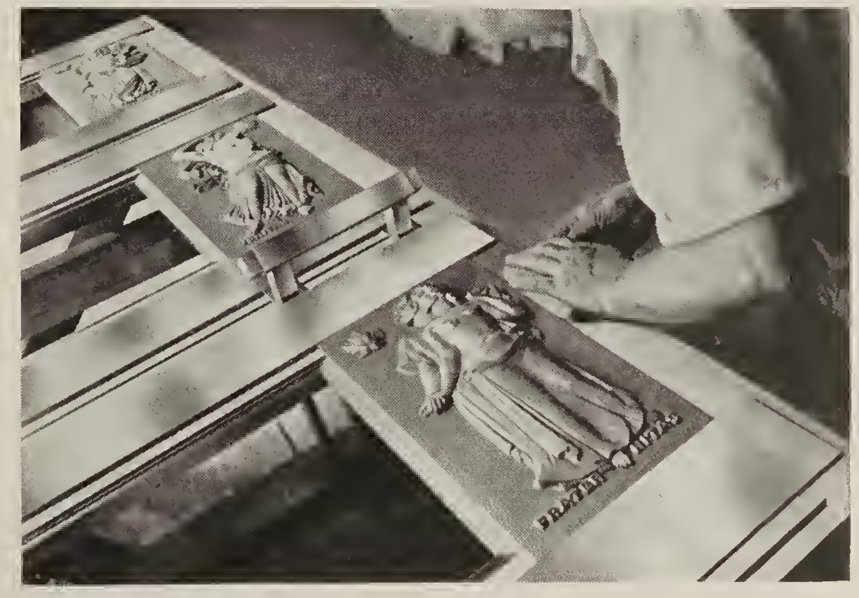
UNITED NATIONS BUILDING
NEW YORK, N. Y.

The doors of Nickel Silver installed at the entrance to the United Nations Building, New York, were a gift from Canada. They are made of Nickel Silver sheet, bars, extrusions and castings.

Harrison & Abramovitz, Architects
New York, N. Y.

Robert Mitchell, Fabricator
Montreal, Canada

Expert workmen apply finishing touches to this excellent example of Nickel Silver in architecture.



FIELD HOUSE,
UNITED STATES NAVAL ACADEMY
ANNAPOLIS, MARYLAND

A Copper roof recommends itself for use in a seacoast locality. A barrel-vault roof may account for half the exterior surface of a building; therefore, color is an important architectural consideration. In a seacoast atmosphere Copper will, in a few years, attain a permanent blue-green patina.

Harbeson, Hough, Livingston & Larson and
Von Storch, Evans & Burkavage, Architects
Philadelphia, Pennsylvania

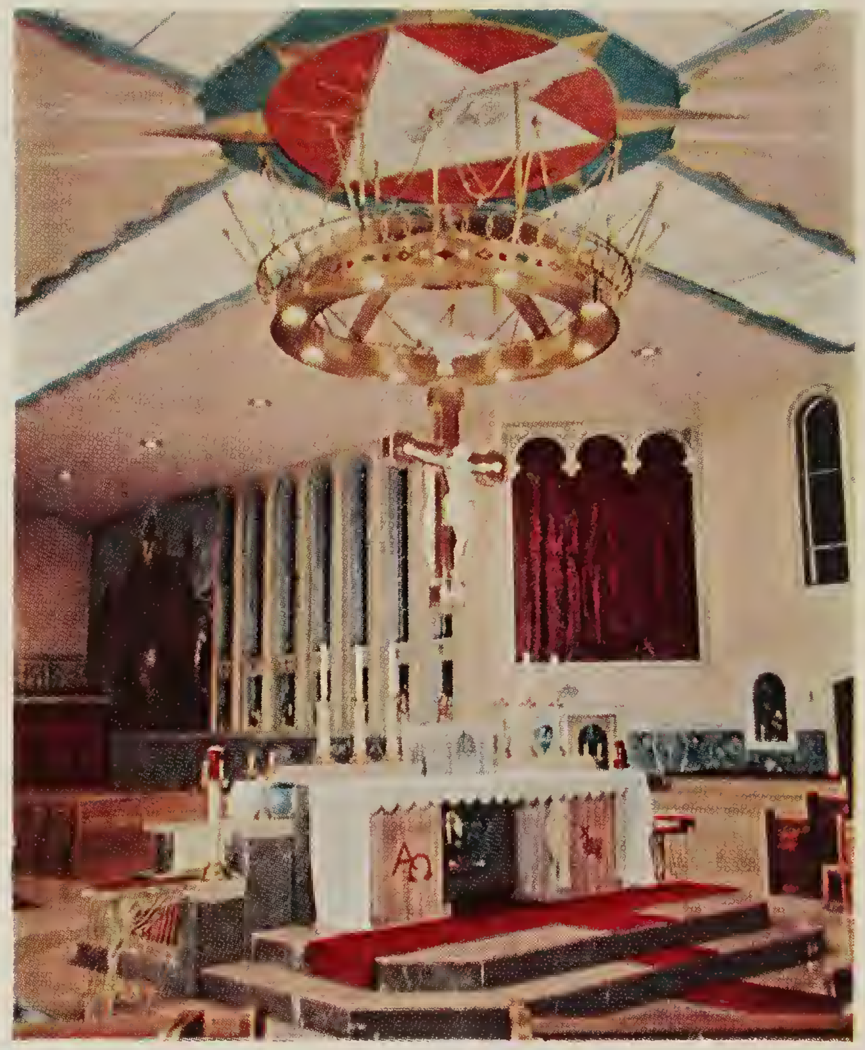
Overly Manufacturing Company, Sheet Metal Contractor
Greensburg, Pennsylvania

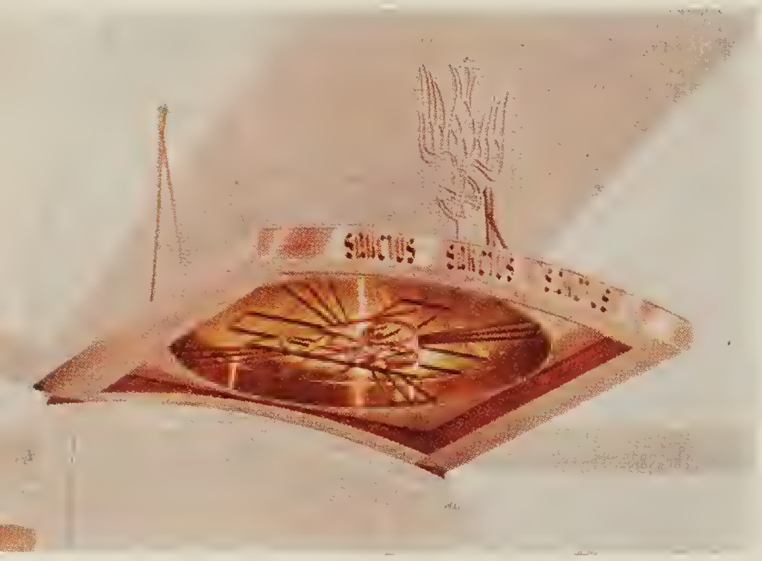
Field house roof used 136,000 pounds of Sheet Copper, and covers an indoor area 200 by 370 feet.

CHRIST THE KING THEOLOGICAL SEMINARY
CHICAGO, ILLINOIS

An interesting use of Bronze to enhance the solemn beauty of this altar.

Greco Manufacturing Company, Fabricator
Chicago, Illinois





ST. HILARY CHURCH
CHICAGO, ILLINOIS

The Bronze baldachin over the altar is noteworthy in that the dome, 8′ 8″ in diameter, is said to be the largest architectural spinning ever made.

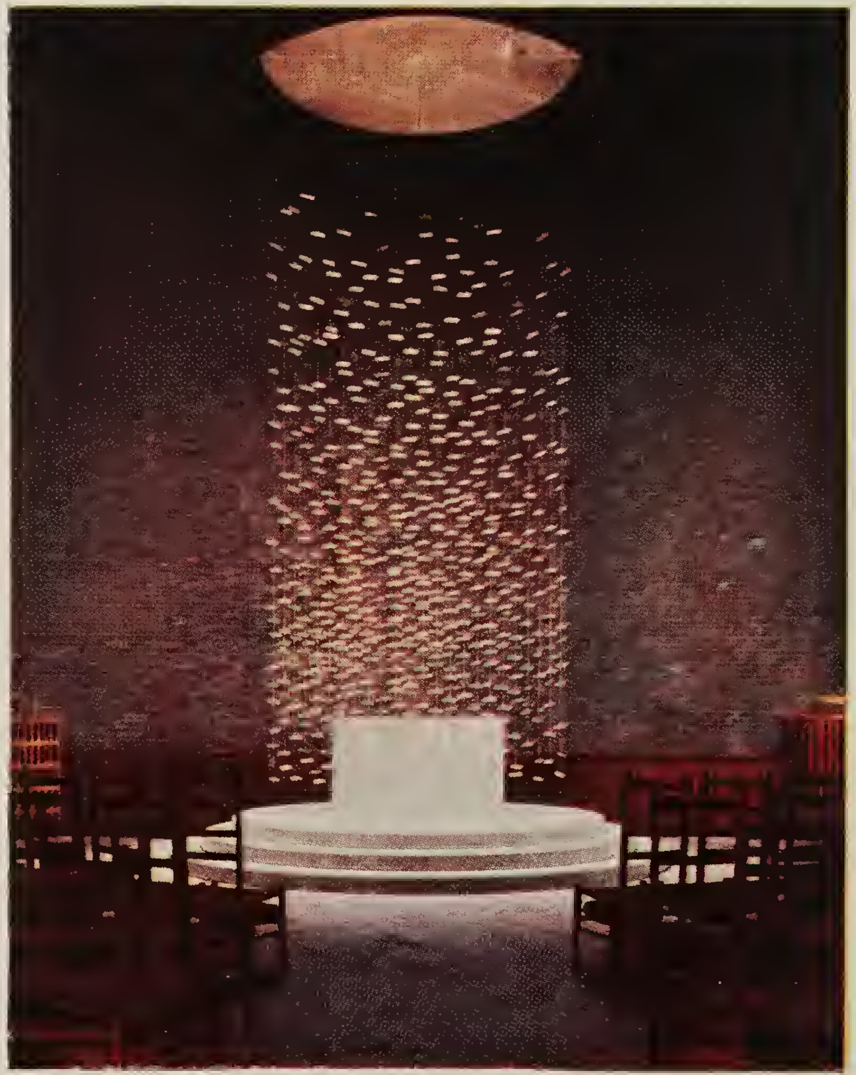
Greco Manufacturing Company, Fabricator
Chicago, Illinois

KRESGE CHAPEL
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE, MASSACHUSETTS

The scintillating reflections of warm light are from the delicate reredos (screen of Brass and Bronze behind the altar). This unusual effect was accomplished through simple welded sculpture.

Eero Saarinen, Architect
Bloomfield Hills, Michigan

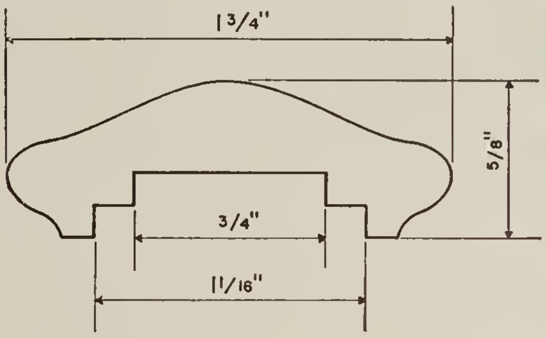
Harry Bertoia, Sculptor
Bally, Pennsylvania

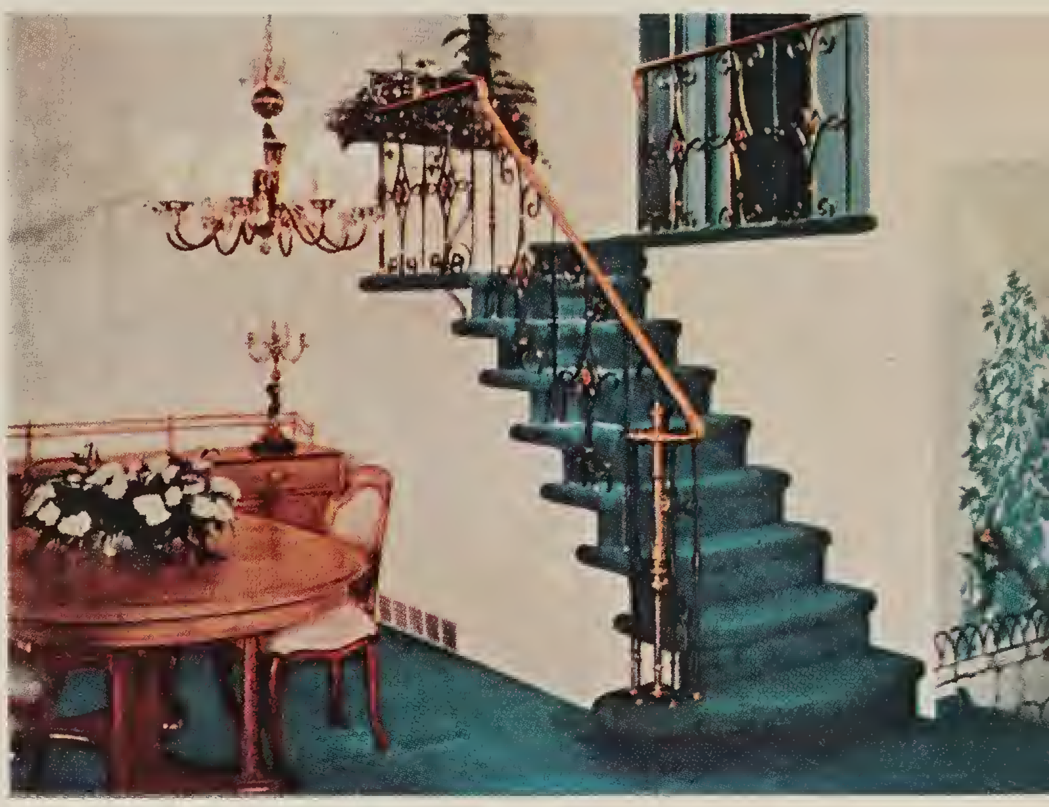


STAIR RAILING
RESIDENCE OF MR. BERNARD GOLDSTEIN
WYNCOTE, PENNSYLVANIA

Here is a beautiful, simple stair railing in which the Bronze handrail, rosettes and newel provide an unusually colorful touch. The smooth bends at the easements and at the volute are made possible by the stocky cross section of the special handrail.

M. Cohen & Sons, Fabricator
Philadelphia, Pennsylvania





DINING ROOM "E"
SOCONY MOBIL BUILDING
NEW YORK, N. Y.

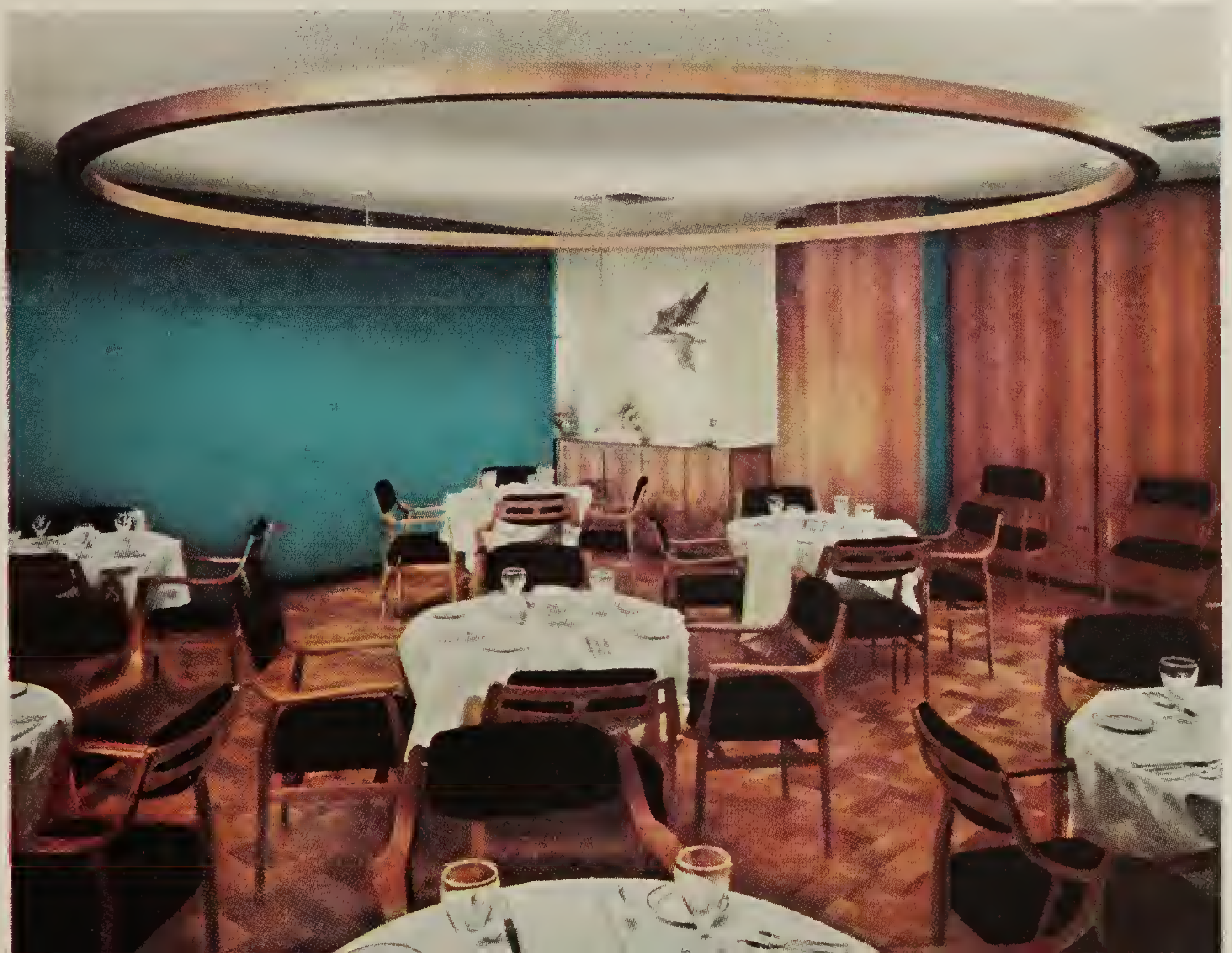
A novel and decorative arrangement of indirect lighting, utilizing a channel-shaped ring of Bronze, provides uniform light on the tables. The reflected light has a softening influence on all colors of materials, including the Bronze.

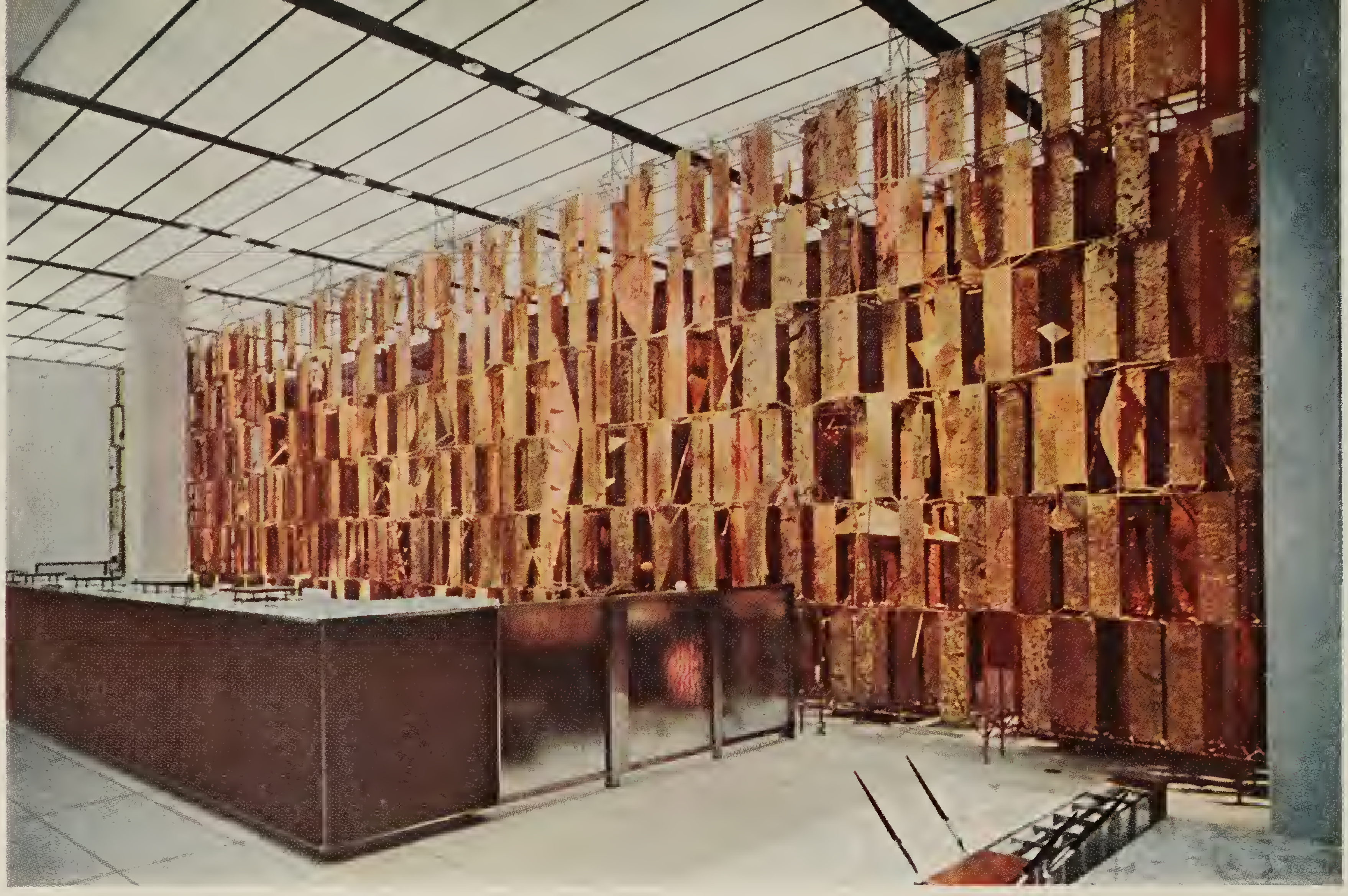
The Antique Bronze flying geese on the far wall are executed in modern welded sculpture.

Harrison & Abramovitz, Architects (Building)
New York, N. Y.

J. Gordon Carr, Architect (Interior and Lounge)
New York, N. Y.

Barbara Lekberg, Sculptress
New York, N. Y.



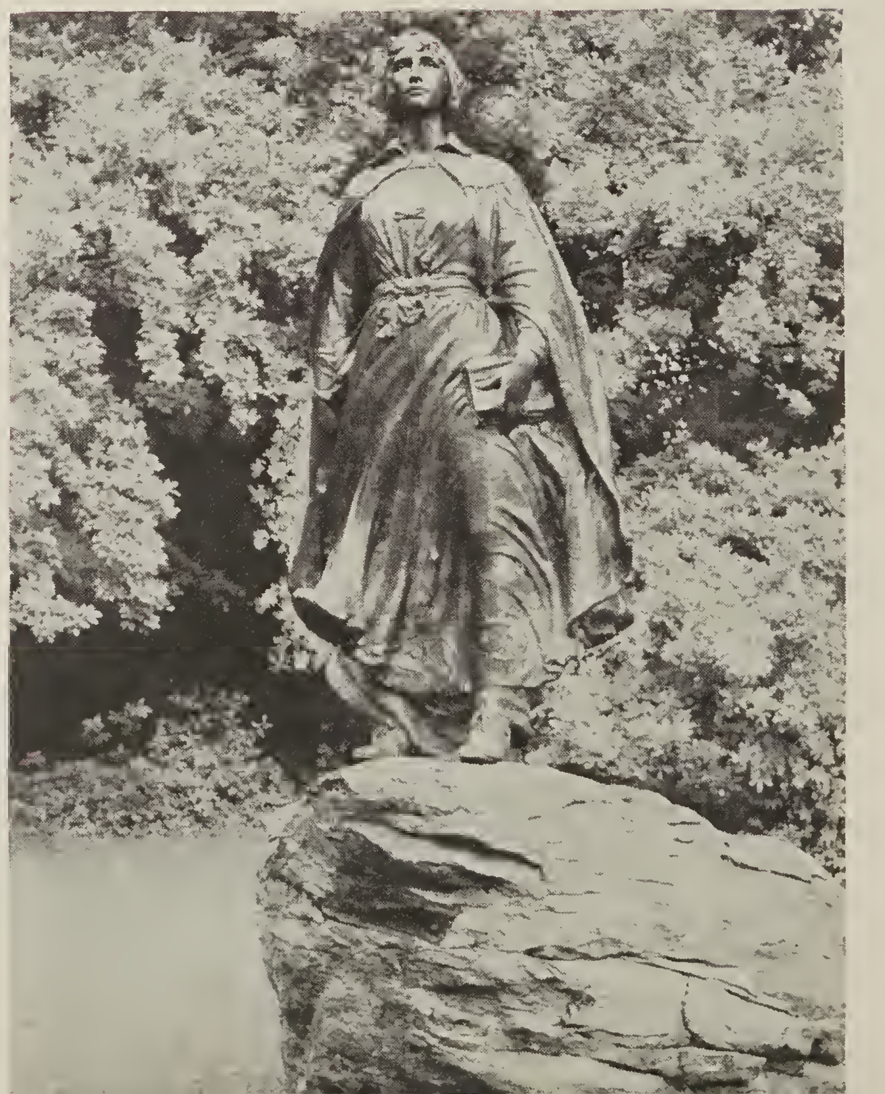


MANUFACTURERS TRUST COMPANY
NEW YORK, N. Y.

This decorative screen provides a feeling of warmth, and a pleasant contrast with the white metal interior of the bank. The work was done by welding, a technique currently in vogue to produce unusual design effects. In this case it consists of steel plates on which the sculptor has deposited Nickel Silver and several other bright alloys of Copper in artistic color patterns and textures.

Skidmore, Owings & Merrill, Architects
New York, N. Y.

Harry Bertoia, Sculptor
Bally, Pennsylvania



THE PILGRIM MAIDEN

A Bronze monument to the Pilgrim Maidens, Brewster Park, Plymouth, Massachusetts.

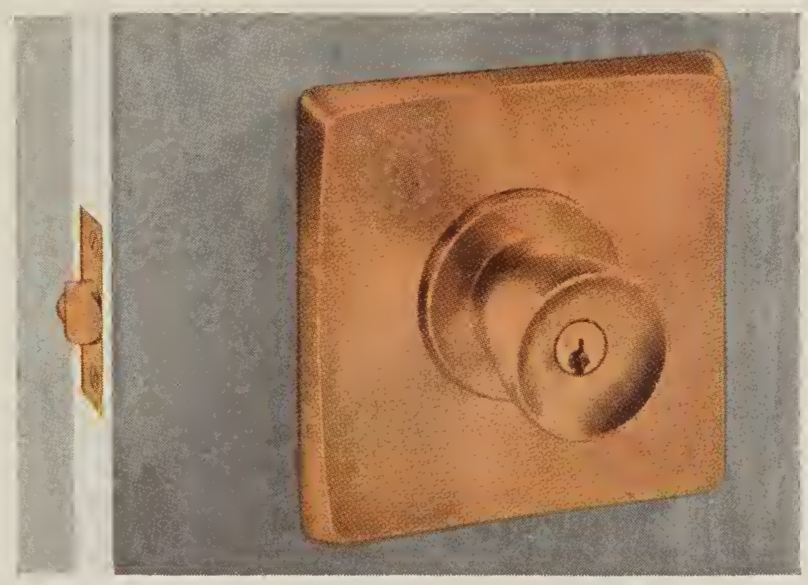
Henry Kitson, Sculptor

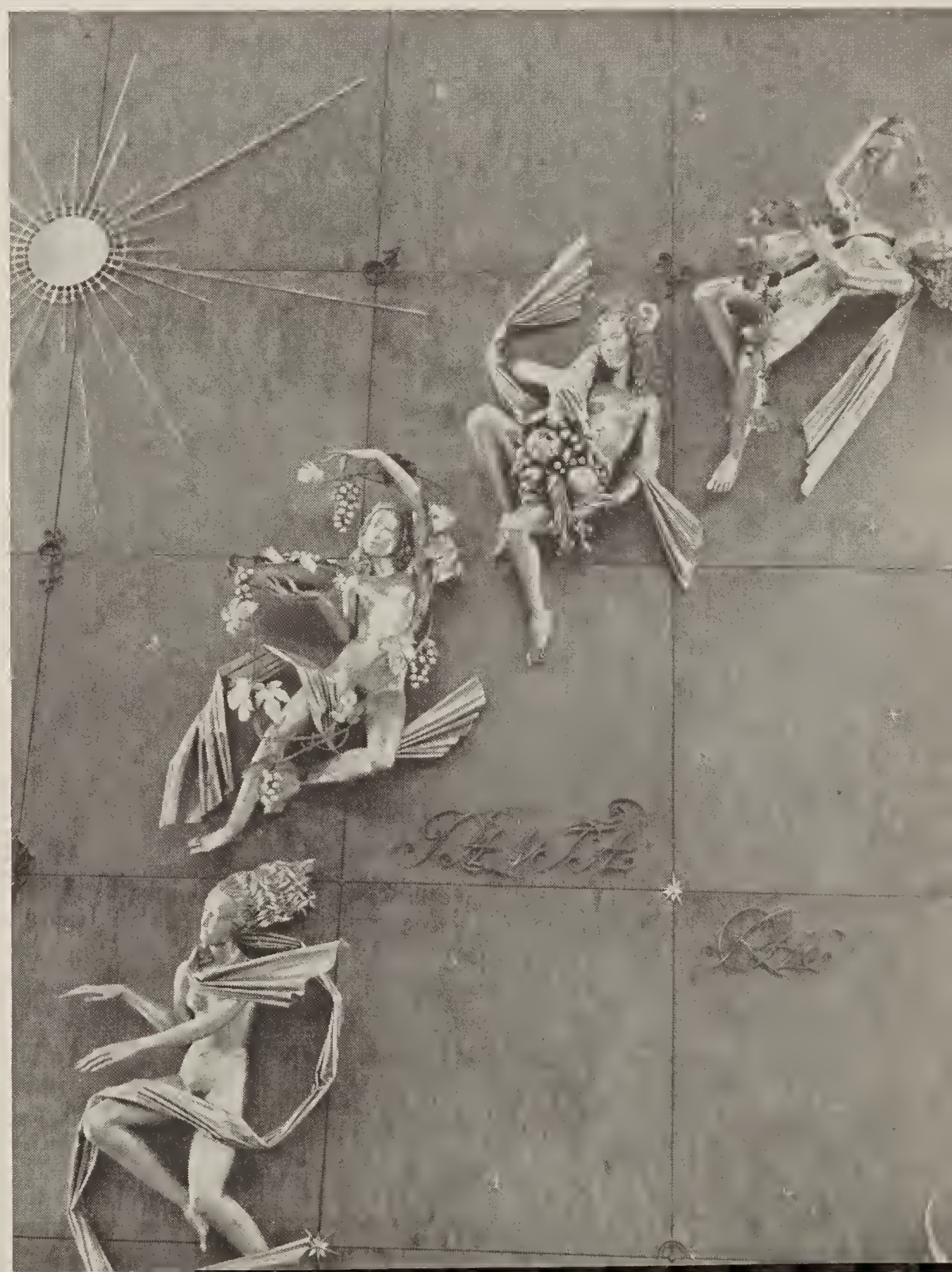
HARDWARE

Finish hardware is an important part of good architecture. The principal requisites are that the hardware be of good design, attractive and harmonious in color, of substantial construction and of a material which, with reasonable attention and maintenance, will retain its original finish and appearance. From a practical and service standpoint, the metal should be the most workable in the way of easy machining, free cutting, stamping, deep drawing, forging or spinning, depending on the part involved. The metal should also have the proper hardness to take a good finish: not so soft that it can be easily scratched nor so hard that the metal is difficult to work.

Brass, Bronze and Nickel Silver satisfy all of the practical and aesthetic requirements and, in fact, they are almost indispensable for cylinder locks, panic bolts, latches and other wearing and moving parts.

Inferior hardware can quickly and devastatingly spoil excellent architecture; therefore the use of substitute materials in place of Solid Brass, Bronze or other Copper Alloys is not justified.





THE FOUR SEASONS
S. S. NIEUW AMSTERDAM
HOLLAND-AMERICA LINE

Mural in Cast and Wrought Brass, with a background of Copper wall panels, artificially patinated.

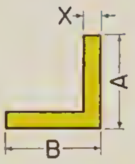
chapter 5

STANDARD SHAPES

This is a listing of the sizes most commonly used in architectural work. For complete list see Anaconda Publication B-37—Anaconda Structural Shapes (A.I.A. File No. 13-B).

EXTRUDED ANGLES

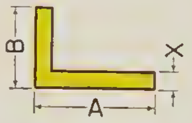
Equal Legs



Size—Inches

X		A		B	Lb/Ft.
.094	x	.375	x	.375	.22*
		.500	x	.500	.31*
		.625	x	.625	.36*
		.750	x	.750	.48*
.125	x	.500	x	.500	.42
		.625	x	.625	.52
		.750	x	.750	.64
		1.00	x	1.00	.86
		1.25	x	1.25	1.09
		1.50	x	1.50	1.31
		1.75	x	1.75	1.55
		2.00	x	2.00	1.79
		2.50	x	2.50	2.25
.188	x	1.00	x	1.00	1.24
		1.25	x	1.25	1.60
		1.50	x	1.50	1.92
		2.00	x	2.00	2.61
		2.50	x	2.50	3.29
.250	x	1.25	x	1.25	2.05
		1.50	x	1.50	2.52
		2.00	x	2.00	3.42
		2.50	x	2.50	4.33
		3.00	x	3.00	5.25
		4.00	x	4.00	7.07*

Unequal Legs

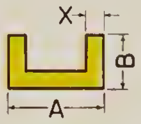


X		A		B	Lb/Ft
.125	x	.750	x	.375	.45
		.750	x	.500	.52
		1.00	x	.500	.65
		1.00	x	.750	.75
		1.25	x	.500	.75
		1.25	x	.750	.85
		1.25	x	1.00	.97
		1.50	x	.500	.84
		1.50	x	.750	.97
		1.50	x	1.00	1.10
		2.00	x	1.00	1.33

* Not available in Nickel Silver

EXTRUDED CHANNELS

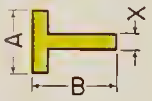
Equal Legs



Size—Inches

X		A		B	Lb/Ft
.094	x	.375	x	.375	.33*
		.500	x	.500	.45*
		.750	x	.375	.45*
		.750	x	.750	.70*
.125	x	.500	x	.375	.46
		.750	x	.375	.57
		.750	x	.500	.68
		.750	x	.750	.90
		1.00	x	.375	.69
		1.00	x	.500	.81
		1.00	x	.750	1.04
		1.00	x	1.00	1.25
		1.25	x	.500	.91
		1.25	x	.625	1.02
		1.25	x	1.25	1.60
		1.50	x	.375	.91
		1.50	x	.500	1.02
		1.50	x	.625	1.15
		1.50	x	.750	1.26
		1.50	x	1.00	1.48
		1.50	x	1.50	1.94
		2.00	x	.750	1.48
		2.00	x	1.00	1.71
		2.25	x	.875	1.71

EXTRUDED TEES

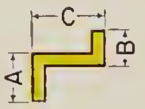


Size—Inches

X		A		B	Lb/Ft
.125	x	.750	x	.750	.64
		1.00	x	1.00	.86
.188	x	1.50	x	1.50	1.94

EXTRUDED ZEES

.125″ thick



Size—Inches

A	B	C	Lb/Ft
.500	1.00	.750	.92
.500	.750	1.00	.87
.750	.875	1.75	1.43

ALLOYS. Extruded Angles, Channels, Tee and Zee Sections, L Shapes and Round and Rectangular Rods are furnished in Architectural Bronze, and in 10% and 13% Nickel Silver unless otherwise noted.

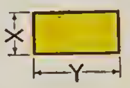
Drawn Angles, Channels and Rectangular and Round Tubes are available in Red Brass and Yellow Brass. The Round and Rectangular Tubes can also be obtained in 10% and 15% Nickel Silver.

Light Structural Shapes in Everdur-1010 alloy are available in the form of Angles, Channels, Tees and I Beams. See Anaconda Publication B-37.

Weights per foot are given as approximate.

EXTRUDED ROD

Rectangular



Size—Inches

X		Y	Lb/Ft
.125	x	.500	.228*
		.625	.285*
		.750	.342*
		1.00	.456
		1.25	.570
		1.50	.684
		2.00	.912
		2.50	1.141
.188	x	.500	.342*
		.625	.428
		.750	.513
		1.00	.684
		1.25	.855
		1.50	1.027
		2.00	1.369
		2.50	1.711
		3.00	2.053
		3.50	2.402
.250	x	.375	.342*
		.625	.570
		.750	.684
		1.00	.913
		1.25	1.141
		1.50	1.369
		2.00	1.825
		2.50	2.281
		3.00	2.737
		4.00	3.650
.375	x	.500	.684
		.750	1.027
		1.00	1.369
		1.25	1.711
		1.50	2.053
		2.00	2.737
		2.50	3.422
		3.00	4.106
.500	x	.750	1.369
		1.00	1.825
		1.25	2.281
		1.50	2.737
		2.00	3.650
		2.50	4.562
		3.00	5.475
.750	x	2.00	5.475
		2.50	6.844
1.00	x	2.00	7.300
		2.50	9.125

EXTRUDED ROD

Square

Size–Inches	Lb/Ft
.250	.2303*
.313	.3598*
.375	.5181
.500	.9210
.625	1.439
.750	2.072
1.00	3.684
1.25	5.756
1.50	8.289

Round

Size–Inches	Lb/Ft
.250	.1808*
.313	.2826*
.375	.4069
.500	.7234
.625	1.130
.750	1.628
1.00	2.893
1.25	4.521

* Not available in Nickel Silver

DRAWN TUBE

Rectangular

Size–Inches Wall		Outside Dimensions			Lb/Ft
.064	x	.500	x	1.00	.65
		.750	x	1.50	1.00
.081	x	.750	x	1.50	1.23
.072	x	.750	x	2.00	1.37
.064	x	1.00	x	2.00	1.35
.081	x	1.25	x	3.00	2.43
.064	x	1.00	x	1.50	1.12
.081	x	1.25	x	2.50	2.15
.081	x	1.50	x	3.00	2.58
		1.75	x	3.00	2.73
		1.75	x	4.00	3.32
		1.75	x	4.50	3.84
		1.75	x	5.00	3.92
		2.00	x	3.00	2.88
.102	x	1.00	x	3.00	2.85

DRAWN TUBE

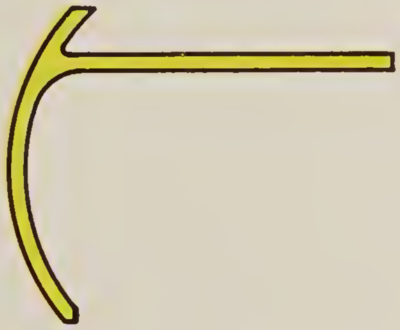
Square

Size–Inches Wall		O.D.	Lb/Ft
.051	x	.500	.33
.064	x	.625	.53
		.750	.65
		1.00	.88
.081	x	1.25	1.38
		1.50	1.69
		2.00	2.28
.091	x	1.25	1.55

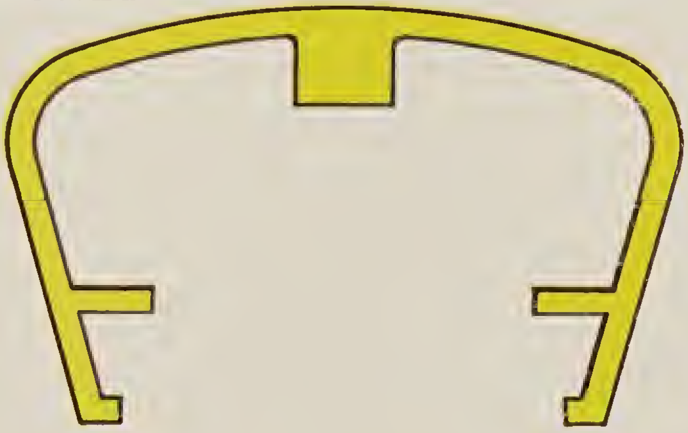
Round

Wall		O.D.		I.D.	Lb/Ft
.146	x	1.660	x	1.368	2.63
.150	x	1.900	x	1.600	3.13

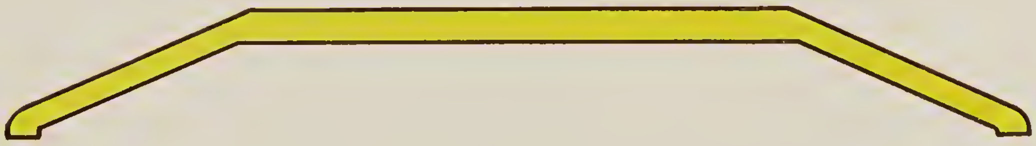
EXTRUDED BRONZE NOSING

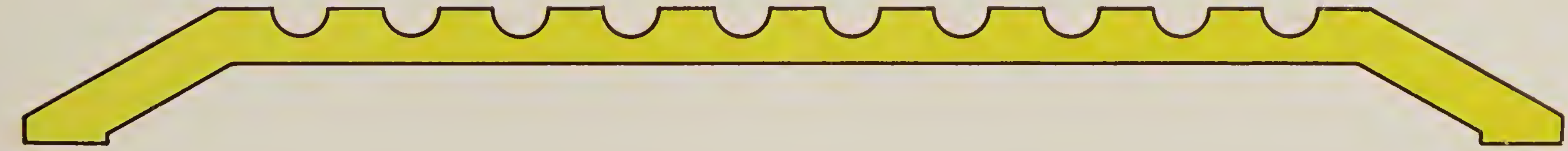


EXTRUDED BRONZE HANDRAIL



EXTRUDED BRONZE THRESHOLDS





chapter 6

FABRICATING TECHNIQUES

CRAFTSMANSHIP

Laying out the work

Execution of architectural metalwork calls for only the best in workmanship. Work of the highest quality is a product of love for the art, skill in the use of good tools, and patience. A finished work is usually judged by the appearance of the material and by the fineness of the joints. Good work never shows signs of rough usage or careless handling; on the contrary, the material is flawless and the joints show evidence of the utmost care. To make a perfect joint the cuts must be square, straight and true, the lengths must be right for a snug or driving fit, and the alignment must be exact.

TOOLS AND EQUIPMENT

Shop facilities

To utilize the many materials and the forms in which they are available, and to make use of all the skills of the practical arts, it is helpful to know what tools and equipment are generally available in the fabricator's shop. The work begins on a heavy worktable having parallel sides and square corners, where the laying out is done. Nearby are the power shear and brake; saws and bending tools; and facilities for punching, drilling and tapping, as well as for soldering, brazing and welding. Fully equipped shops have a furnace, forge and anvil, spinning lathe and metal finishing equipment, including tanks for dipping and cleaning.

CUTTING AND FITTING

Methods

Wrought metals of Copper, Brass, Bronze and Nickel Silver are assembled by methods that have been standard in machine work for many years. The work begins by forming and cutting to size the parts that make up the unit, whether it is a door, a window, or any architectural treatment. The cutting is normally done with a circular saw or band saw, but shearing is permissible where the edges of the metal do not show in the finished work. The faces of the finish cuts are trued and smoothed by grinding with emery or carborundum, or by filing, and the parts are put together and fastened temporarily with screws, bolts or clamps, depending on the size and character of the work. Permanent fastening or joining of the several parts is usually accomplished by means of concealed screws, reinforced soldering, silver-alloy brazing or by welding.

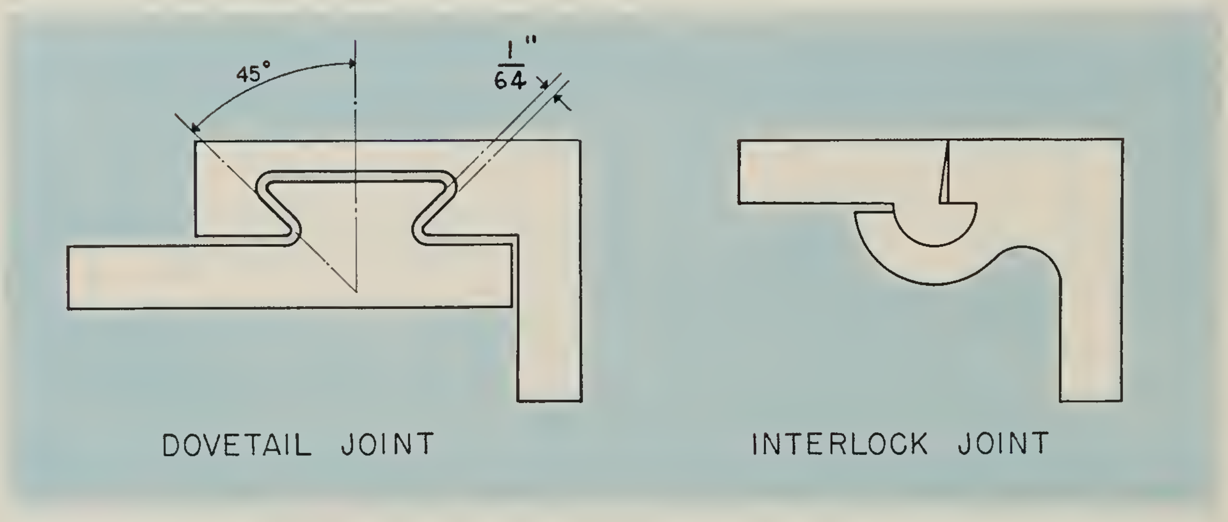
JOINING

Soldering and Mechanical fastening

A common method of joining copper-alloy architec-

JOINTS FOR

CLOSED EXTRUSIONS



DOVETAIL JOINT

INTERLOCK JOINT

tural metals is by soldering. The joints are strengthened by reinforcements on the reverse side, consisting of short pieces of angles and flats pressed into the solder while hot and sweated solidly into place. Round or flat-head rivets or exposed screw fastenings are sometimes employed for architectural effect. Flush rivets have become less popular because they eventually tend to show hairline circles around the flush faces of the rivets.

Welding and brazing

For work that is large in scale, welded joints are the most satisfactory . . . provided that the metals to be joined are weldable, the welding is done by experts, and a good color match is obtained. Another common method of joining is by silver-alloy brazing. If the parts are carefully fitted and the brazing skillfully done, hairline joints that might show are not considered objectionable.

Oxyacetylene welding

Oxyacetylene welding may be employed in many cases. With this process the low heat-input rate means slow welding speed, which makes for good control. However, it may produce excessive distortion and discoloration.

Resistance welding

Electrical resistance welding is useful for joints that cannot be seen or for reinforcement, but is undesirable on exposed facings because of the unavoidable electrode marks left on the metal.

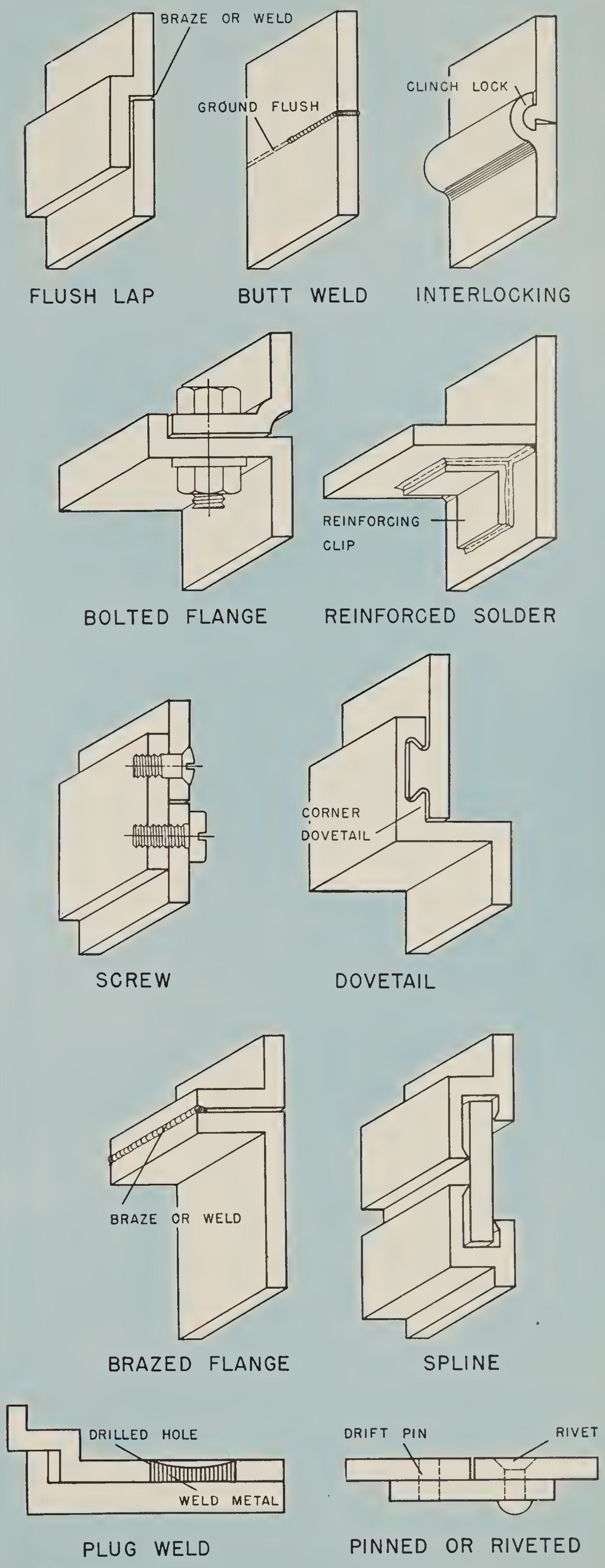
Inert-gas tungsten-arc welding

This process produces good results on zinc-free alloys. However, on zinc-bearing metals vaporization of zinc may be a source of difficulty by interfering with fusion of weld and base metal.

Carbon-arc welding

This process gives excellent results on Everdur.

JOINTS FOR EXTRUDED METALS



FLUSH LAP

BUTT WELD

INTERLOCKING

BOLTED FLANGE

REINFORCED SOLDER

SCREW

DOVETAIL

BRAZED FLANGE

SPLINE

PLUG WELD

PINNED OR RIVETED

chapter 7

METAL FINISH
COLOR AND SURFACE TREATMENT

ABRADED FINISH

Types of finishes

The common finishes in architectural metalwork are sandblasting for castings, etched finishes for plates, and polished or matte finishes for wrought metals of all kinds. The simplest and least expensive finish for plain metals is the "mill-scale finish", produced by "cutting down" or removing tool and die marks with a No. 80- and No. 120-grit sanding belt, or by a canvas or felt wheel.

Satin finish

Further refinement with a No. 240-grit belt, a Tampico brush (shredded fiber wheel), a muslin wheel, or by hand, using the proper compound, will result in a "satin finish". This is the best and most suitable finish for architectural metals. A still finer finish can be obtained through the use of No. 220 Turkish emery in oil, followed with a cotton wheel buff using the correct compound. Such a finish is for builders' hardware and other metalwork that is subject to close inspection.

Scratch-brush finish

A scratch-brush finish with a fine-wire wheel of brass or nickel silver wire is very attractive and is commonly used in finishing hardware.

SANDBLASTING

Texture

Sending blasts of sand or other abrasive granules against the surface of metals produces a textured finish that is very pleasing to the eye. The fineness or coarseness of texture can be varied, but the average, resembling No. 0 sand paper, is usually satisfactory for architectural effect.

Castings

Sandblasting is particularly suitable for finishing castings, since it eliminates a great deal of grinding, chasing and polishing, although minor selective polishing for highlights and for architectural accent is often deemed desirable.

Plates

Flat metals are less suited to sandblasting because of their tendency to warp under the impingement of the sand or aluminum oxide granules. However, plates $\frac{3}{16}''$ thick or heavier and extruded thresholds can be sandblasted satisfactorily.

ETCHING AND ENGRAVING

Finite detail

These creative arts for producing sinkages in metalwork have a proper place in architecture and the possibilities in design are unlimited.

Etching

Etching is usually employed for creating a textured background for a design, mostly in sheet metal. Some of the metal is eaten away by nitric, hydrochloric or other acids without warping or buckling the metal, even though it might be quite thin. The design is made with an etching needle by scraping away the "ground" composed essentially of wax, gum resin and bitumen.

Engraving

Engraving with engravers' tools and photoengraving are used sparingly, but are very effective in fine work as part of an architectural treatment. This art has a place in inscriptive decoration such as slabs or panels, in lobbies, elevator cabs, and on interior furnishings of metal.

COLOR

In architecture with copper and alloys of copper the designer has a choice of several colors or color combinations. This ranges from the natural color of the bright metals, through a variety of natural and accelerated color effects, to the ultimate and distinctive patina that is peculiar to each of the respective metals and which develops on exposure to the weather.

COPPER

Natural and artificial coloration

Copper is essentially an outdoor metal and in architecture is usually allowed to weather naturally. Nevertheless, some striking effects can be obtained by finishing the metal in its natural salmon pink, or reddish orange, with possibly a slight artificial coloring for interior decoration. On exposure to the weather, copper takes on a vivid, but mellow, green patina. This evolves through several stages, from the new metal to a deep brown, to a milky brown and to the final bloom of the patina. Normally this takes about seven years at the seacoast and about twelve years inland.

Artificial means are sometimes used to produce the patina on copper, but the natural patina that comes by weathering is more desirable. To obtain the patina artificially, the copper is sprayed or swabbed with a solution of ammonium sulfate or ammonium chloride and water. See detail specification, pages 61 and 62.

RED BRASS, ARCHITECTURAL BRONZE AND MUNTZ METAL

Statuary bronze coloring

These metals lend themselves exceptionally well to chemical treatment for artificially producing colors

Pioneer Woman—a proud commemorative masterpiece in Bronze, located in Ponca City, Oklahoma. The statue is 17 feet high and weighs 12,000 pounds. Bryant Baker, Sculptor that rival the beauty of the best examples of weathered bronze. Red Brass colors more easily than the other two metals—simply by applying commercial "liver of sulfur".

Because of the high zinc content in Architectural Bronze and Muntz Metal, it is expedient to apply a dilute solution of cupric chloride containing a small amount of hydrochloric acid which will form a thin copper film on the metal. The surface will then color readily by applying a solution of "liver of sulfur". To produce good color is somewhat of an art and may require several applications, with intermediate drying and relieving of the color to obtain the desired effect.

Dark finish

An ebony or gun-metal finish can be obtained by applying a solution of antimony chloride directly to the metal after it has been thoroughly cleaned. Two or more applications may be required. Heat from an open flame or in a furnace will darken the color.

Natural patina

If copper alloys are not treated but are allowed to weather, they will eventually take on a mixed green-gray-brown patina, but never the bright blue-green of patinated unalloyed copper.

SURFACE COATING OF OIL OR WAX

Lustrous antique effect

The dry, abraded finishes on architectural metals are very handsome but can be improved on by the application of surface coatings, of which there are several varieties. For metals, except roofing, that are weathered or artificially colored to an antique effect, oils or wax are the most suitable. They bring out a rich luster and a depth of color that is very satisfying. Moreover, the metals can be cleaned and maintained much more easily than if lacquer coatings were used. The more popular oils are lemon oil, straw paraffin oil, linseed oil, and castor oil. At one time the standard specification called for carnauba wax, but now there are several brands of commercial paste wax that are perfectly satisfactory. Whether the coating is to be oil or wax, the metal should be clean and dry. These coatings look their best if they are rubbed on, and then rubbed down vigorously with a dry cloth.

RESINOUS OR LACQUER FINISHES

Bright finish

There are several transparent film-type coatings of natural or synthetic resins that will preserve the bright color of copper, brass and bronze for a year or more outdoors and for a number of years indoors. A single spray coating of the proper thickness over clean, dry metal is generally sufficient. Manufacturer's directions should be followed.

PORCELAIN ENAMEL

Dramatic color with enamel

The art of enameling architectural metals has advanced a great deal over the last few years. There is the high-temperature enamel for steel, and the newly developed, low-temperature leaded enamel for aluminum. Both are applicable to copper or bronze and can be used to advantage where only a part of a panel or design is to be enameled, somewhat on the order of cloisonné. All enameled metals are very suitable for composite design with Copper, Brass, Bronze and Nickel Silver, and for building and store front facings in modern architecture.

PROTECTION

For handling

All finished materials that are ready for delivery should be protected from physical damage during handling, both in transit and on the job, and from soiling and staining. Materials with a fine finish that are wiped with oil, waxed or lacquered should be wrapped in paper and placed in suitable shipping cases. Spacers and padding should be provided to avoid chafing of the sides and edges.

After installation

After the metalwork is installed, it is usually cleaned of soil marks and given a wiping of lemon oil or paste wax as a temporary protection and to prevent scratching of the metal. The more vulnerable parts can be wrapped with waterproof paper and taped, or the metals can be given a sprayed strippable plastic coating. All protective coatings are removed and the metals given their final attention just prior to acceptance of the job.

chapter 8

MAINTENANCE

ANALYSIS

Maintain the metals of your architecture

To take full advantage of the lasting beauty of bronze, it is important to give this metal the care it deserves through proper maintenance. The term "Bronze" used in this section on maintenance is understood to mean all copper alloys commonly used in architecture, except Nickel Silver.

Bronze has many faces

Bronze, whether in the natural color or with a waxed or oiled statuary bronze finish, enlivens all building materials regardless of whether they are light or dark, and there are no combinations of building materials so satisfactory as bronze and glass, or bronze and stone. Bronze can be finished and refinished from light to dark and back again at will, without injuring the metal. Therefore, it is possible to change the color effect from time to time and to alter the plan of maintenance to suit one's taste and economy.

Selection of finishes

In the past it was generally accepted that the bright, natural color of bronze was the more beautiful architecturally. More recently the trend of thought has been in the direction of oxidized, or weathered bronze for the architecture on the exterior, and a bright-finished bronze for the interior. If desired, the conservative appearance of the weathered bronze can be enlivened by highlighting or by employing a bright finish to parts of the work, such as the nameplate, handrail, entrance doors, grilles and finish hardware. Occasional cleaning and wiping is required with all metals, but if the metals are neglected, the appearance of weathered bronze is less affected.

REFINISHING LACQUERED BRONZE

Bright finish

If a new, bright finish is desired, the old lacquer should be removed with "cleaner thinner" by scrubbing with fine steel wool or pumice and water. Tarnish can be safely removed by swabbing with a concentrated solution of oxalic acid (poisonous, if taken internally). Mineral acids should not be used. It may be necessary to rub vigorously with steel wool to obtain a surface of uniform color.

Antique finish (preparation)

For producing an antique effect in refinishing bronze, the first step is to remove the old lacquer. Then, to assure a uniform coloring, the entire surface should be dezincified with a swabbing of acidified copper chloride containing 5% hydrochloric acid. For completing the antique finish, see specifications on "Color and Surface Treatment" (pages 61 and 62).

CAUTION: In working with acids, the operator should wear rubber gloves, goggles and suitable clothing.

RENEWING FINISH ON WEATHERED BRONZE

Restoring old bronze

An easy method is to soften the incrustation of oxide with sodium bisulfate applied with a small paint brush, then rub with fine steel wool and clean with a suitable metal polish. The metal will then be as bright and clean as when first installed, and ready for a new surface treatment.

THREE METHODS FOR MAINTAINING BRONZE

The selection of finish is influenced by personal taste and plan of maintenance.

Plan "A"—Ebony background and highlighted accents

The beauty of bronze at little cost

This is a very handsome finish and the least expensive to maintain. The body color of deep bronze requires only rubbing with oil once or twice a year, and the highlighted portions, such as the doorknobs and escutcheons and possibly a small amount of trim or ornament, should be brightened twice a year by rubbing with an abrasive eraser or with Aloxite cloth or jewelers' cloth.

Plan "B"—Statuary bronze finish with polished doors and architectural objects

An effective color scheme

This plan deals in a rich statuary bronze effect with a bright color accent at the doors. To maintain this finish it should be cleaned with Soilax (two tablespoonfuls in eight quarts water) every two weeks, and rubbed with lemon oil, paraffin oil or wax when it seems necessary to renew the surface finish. The doors are left bare and only require light rubbing with a nonacid-type metal cleaner.

Plan "C"—Bright metals

For a display of quality and color

Bright metals require frequent care to maintain an appearance worthy of their place as an important part of the architecture of a building. If lacquered, they should be cleaned every two weeks and given a light, rubbed-on coating of lemon oil, paraffin oil or wax. On important work the lacquer should be removed to the bare metal when it shows signs of deterioration. Removal of the lacquer requires an application of "cleaner thinner" to soften the incrustation and to lighten the work of cleaning the metal with pumice and water, or steel wool where necessary. In addition, a suitable metal polish may be helpful. After the metal has been cleaned in this manner, all traces of foreign matter should be removed. When thoroughly dry, and without having been touched by bare hands, the metal is ready to receive a new protective coating. Colorless coatings for metals are generally in the order of lacquers.

Method of application

To avoid brush marks and uneven weathering, the protective coating should be applied by the spray method, in one or two light applications as recommended by the manufacturer.

Leave "touch line" bright

For the most satisfactory operation and maintenance, doors and handrails should be left plain, without lacquer, and cleaned and brightened with metal cleaner as often as necessary. A wiped-on coating of paste wax may be found desirable.

Lacquer interior bronze

Interior bronze, except that which is very frequently touched by hands, should be lacquered. Stair rails, handrails, grab bars and doorknobs should not be lacquered, but kept bright with metal polish.

NICKEL SILVER

Outdoor maintenance

Nickel Silver has the characteristic of tarnishing slowly. Outdoors, it becomes coated with a dulling film, as do all metals, but the patina, like that on copper, shows its color through the soiled surface of the metal. An occasional cleaning with soap and water, and metal polish or fine steel wool (depending on the time interval and location) will restore the metal to its original color.

Indoor maintenance

When used indoors, Nickel Silver requires very little care other than wiping. Once or twice a year the metal should be cleaned with a sponge dampened with Soilax and water. Eventually, on occasions of redecorating or when the need for refinishing becomes apparent, the metal should be thoroughly refurbished by rubbing with No. 00 steel wool. For additional luster, the Nickel Silver may be given a rubbed-on coating of wax or lemon oil.

chapter 9

SUGGESTED SPECIFICATIONS

GENERAL

All architectural metals shall be of the best commercial quality and their various forms are to be straight and true. There shall be no scratches, scars or creases, buckles, ripples or chatter marks. Finished surfaces must be suitable for polishing.

All of the parts are to be fabricated and assembled in a skillful and workmanlike manner. The work shall be executed in accordance with approved shop drawings and in conformity with recognized best practice in the trade. The joints shall be strong and weathertight, and the fastenings shall be concealed as far as practicable. The method of joining shall be the best for the particular material and application.

The architectural metals are to be handled carefully and treated with regard for their quality and the importance of their good appearance. Blemishes and damage due to careless handling shall be cause for rejection.

COPPER

Unless otherwise specified, Sheet Copper shall be standard electrolytic tough pitch (ASTM Type ETP) of cornice temper, and shall be of the gage called for on the drawings. Sheet Copper for stamping or spinning shall be cold rolled and annealed, and of 20-ounce gage unless otherwise specified. Copper Bars shall be quarter-hard with commercially square corners, and Copper Tubes shall be of the outside diameter and wall thickness specified and of drawn temper.

RED BRASS

Metal specified as Red Brass shall contain copper, 84 to 86%; lead, .05% max.; iron, .05% max.; other elements, .10% max.; and the remainder, zinc. The materials shall be of the size and gage indicated on the drawings. The drawn shapes shall be finished with drawn temper and commercially square corners (for ordinary work), or, half-hard temper with extra-short-radius square corners (to specification). The plain sheet and strip material, as well as brake-formed sheet, shall be of half-hard, cold-rolled Red Brass. Shape-rolled sections shall be similar to the drawn shapes in quality and temper. Red Brass shall be given a bichromate dip in process so as to match the color of Muntz Metal or Architectural Bronze if those metals are used in the design.

ARCHITECTURAL BRONZE

Extruded shapes, including bars and rods, shall be of Extruded Architectural Bronze containing copper, 55 to 58%; lead, 2 to 3.25%; iron, .50% max.; tin, .50% max.; manganese, .25% max.; other elements, .75% max.; and the remainder, zinc.

MUNTZ METAL

Muntz Metal shall contain copper, 58 to 61%; lead, .35% max.; tin, .25% max.; iron, .15% max.; other elements, .10% max.; and the remainder, zinc.

STATUARY BRONZE CASTINGS

Cast Statuary Bronze shall be of an alloy containing copper, 81 to 85%; tin, 2 to 3%; lead, 1.5 to 2.5%; nickel, .25 to .75 %; iron, .35% max.; other elements, .50% max.; and the remainder, zinc.

YELLOW BRASS

The work that is shown in brass shall be Yellow Brass, consisting of copper, 68.5 to 71.5%; lead, .07% max.; iron, .05% max.; and the remainder, zinc.

The materials shall be of the size and gage indicated on the drawings. The drawn shapes shall be made from annealed stock and finished with drawn temper and commercially square corners (for ordinary work), or, half-hard temper with extra-short-radius square corners (to specification). The plain sheet and strip material, as well as brake-formed sheet, shall be of half-hard, cold-rolled Yellow Brass. Shape-rolled sections shall be similar to the drawn shapes in quality and temper.

YELLOW BRASS CASTINGS

Castings shall be made of an alloy containing copper, 70 to 74%; lead, 1.5 to 3.75%; tin, 0.75 to 2%; iron, .60% max.; and the remainder, zinc.

NICKEL SILVER

13% Nickel Silver extrusions

Extruded shapes of 13% Nickel Silver shall contain copper, 41.75 to 44.75%; nickel, 12 to 14%; manganese, .50% max.; lead, .10% max.; iron, .25% max.; other elements, .75% max.; and the remainder, zinc.

15% Nickel Silver

For sheets and tubes and other wrought forms that are to be used with 13% extrusions, the composition shall be copper, 55 to 58%; nickel, 14 to 16%; manganese, .50% max.; iron, .25% max.; other elements, .25% max.; and the remainder, zinc.

10% Nickel Silver extrusions (alternate)

Extruded shapes of 10% Nickel Silver shall contain copper, 43.5 to 46.5%; nickel, 9.0 to 11.0%; lead, 0.50 to 1.5%; iron, .25% max.; manganese, 2.50% max.; other elements, .75% max.; and the remainder, zinc.

10% Nickel Silver (alternate)

For sheets and tubes and other wrought forms that are to be used with 10% extrusions, the composition shall be copper, 63.5 to 66.5%; nickel, 9.0 to 11.0%; iron, .25% max.; manganese, .50% max.; other elements, .25% max.; and the remainder, zinc.

Nickel Silver—General

The Nickel Silver shall be of the size and gage indicated on the drawings. The drawn shapes are to be made from annealed stock and finished with drawn temper and commercially square corners (for ordinary work), or half-hard temper with extra-short-radius square corners (to specification). Unless otherwise specified, the plain sheet and strip material, as well as brake-formed sheet, shall be of half-hard, cold-rolled 15% Nickel Silver. Shape-rolled sections shall be similar to the drawn shapes in quality and temper.

Nickel Silver castings

Casting ingots shall contain copper, 55%; zinc, 20%; nickel, 12.50%; lead, 10.50%; and tin, 2.00%.

EVERDUR

Everdur wrought forms

Brake-formed sheets as well as rods, bars and tubes of Everdur shall be of the following composition: Silicon, 2.8 to 3.6%; manganese, 0.50 to 1.35%; iron, .25% max.; lead, .05% max.; copper plus the sum of these elements, 99.5% min. Temper to best suit the work.

Everdur castings

Everdur castings shall be of the following composition: Silicon, 3.7 to 4.3%; manganese, 0.85 to 1.35%; iron, .35% max.; nickel, .10% max.; copper plus the sum of these elements, 99.6% min.

COMMERCIAL BRONZE

All sheets, rods, bars and tubes, as well as shape-rolled, drawn, and brake-formed metal, shall be Commercial Bronze of the following composition: copper, 89 to 91%; lead, .05% max.; iron, .05% max.; and the remainder, zinc. Use most suitable temper.

METAL THICKNESSES

The thickness of these materials shall be as shown on the drawings (extrusions ranging from 3/32″ to 3/16″, flat sheet panels and spandrels 1/16″ to 1/8″, and castings 3/16″ or heavier). Tube wall-thicknesses shall suit the requirement.

JOINING

Mechanical joints

The metal-to-metal contacts shall form hairline joints, and all moldings or ornaments are to be in alignment. All exposed joints in flat surfaces shall be flush, unless otherwise shown on the drawings.

The end joints of extruded or drawn shapes are to have sleeves of the same outline as the exposed shapes to make the construction weathertight, to assure good alignment, and to permit expansion and contraction.

When exposed fastenings are desired or cannot be avoided, they shall consist of rivets, screws or bolts.

Screws and bolts

Concealed screw fastenings are to be made with countersunk flat-head machine screws. Exposed fastenings are to be made with oval-head screws, unless otherwise specified. The screws and bolts are to be of the same material as the parts that are joined, so far as possible.

Rivets

Riveting shall be done with solid, tubular or split-shank rivets set in punched or drilled holes. Exposed rivets shall be of the same material as the exposed finish metal or of an acceptable substitute, and the style of head shall be as shown or as approved by the architect. Concealed rivets may be of copper or a suitable copper alloy chosen for its utility, structural strength and economy. The diameter and spacing shall be distinctly marked on the shop drawings.

Joints in Copper

In Sheet Copper of less than 32-ounce gage the joints shall be of the clinch-lock type with a ¾″ lock. If possible, the work is to be made weathertight without solder; otherwise, the joints shall be blind soldered wherever possible. Any necessary face soldering shall be scraped clean to the bare metal. Sheet Copper of 32-ounce gage and thicker shall be joined by soldering and riveting, or by silver-alloy brazing. No solder, except that in a hairline joint, shall be visible. Bar stock shall be assembled with bronze-screw, concealed fastenings wherever possible. Exposed joints requiring strength shall be silver-alloy brazed, or made secure with countersunk oval-head bronze machine screws or stove bolts.

Joints in Red Brass

All joints shall fit perfectly and are to be made flush and strong with proper reinforcement. A dry joint is preferred where practicable, but a hairline joint of lead-tin solder or silver-brazing alloy is permissible. Concealed joints are to be made with countersunk screws or by resistance spot welding.

Joints in Extruded Bronze

All Extruded Bronze shall be cut to exact lengths, put together with clamps and assembled with a snug, driving fit. The joining shall be done principally with screws, but where added strength is required, the joints may be silver-alloy brazed. (Oxyacetylene welding may also be done, using filler-metal strips cut from the base metal, but the joints will never be completely free of porosity.) Concealed joints can be made with countersunk screws or by resistance spot welding. Exposed screw fastenings shall be made with countersunk oval-head machine screws, or with stove bolts of Muntz Metal or Red Brass.

Joints in Muntz Metal

Muntz Metal spandrels shall be flat and set in place against a sealant, then made secure with removable bronze stops. This metal does not lend itself to cold working; therefore, severe bending and stressing of the metal is to be avoided.

Muntz Metal and Yellow Brass can be joined by soft soldering and silver-alloy brazing, and may be successfully oxyacetylene welded with low-fuming bronze rods, such as Anaconda-997 (Low Fuming) Bronze, conforming to ASTM Specification B259, Classification RCuZn-C.

Joints in Yellow Brass

In joining Yellow Brass, it is important that the workmanship be of the finest because of the bright color and finish and the reflectivity of the metal. Use pin and flush-rivet connections, and concealed sweat soldering. Binding of the several parts may be done with a clasp, clevis, or with windings of round or rectangular brass rod or wire. All of the metal including the fastenings shall be of the same alloy.

Muntz Metal and Yellow Brass can be joined by soft soldering and silver-alloy brazing, and may be successfully oxyacetylene welded with low-fuming bronze rods, such as Anaconda-997 (Low Fuming) Bronze, conforming to ASTM Specification B259, Classification RCuZn-C.

Joints in Nickel Silver

In general, the connections shall be made with screws and bolts or by welding. Soft soldering may also be employed. The members shall be cut to exact length and the work is to be assembled to a tight, driving fit. Miters and other joints that must be made weathertight shall be silver-alloy brazed and ground flush, smoothed and finished to match the surrounding material. (Oxyacetylene welding may be possible on certain alloys using the nickel silver type of welding rod, Anaconda Nickel Silver-828, but color match is not always of the best.) Bolts, screws, pins, weld metal and other accessory materials shall be selected to harmonize in color.

Joints in Everdur

All joints and fastenings shall be concealed, if possible, and those that are exposed shall be welded and finished smooth, so as to make the joints invisible. Screws, bolts, pins and other accessories are to be of Everdur.

Solder joints

The solder shall be an approved brand of 50-50 lead-tin alloy. Rosin is a suitable flux for Copper, but the paste-type fluxes should be used on other metals. Solder may be used for concealed joining and reinforcing of architectural metalwork, but is used mostly in joining Copper. Under no conditions shall solder be visible on the face of the work.

Brazed joints

Unless otherwise specified, well-fitted butt joints may be brazed with copper-phosphorus alloy or silver alloy, conforming to ASTM Specification B260, Classifications BCuP-5 and BAg-1, respectively. Clean the joint thoroughly, and apply the proper flux before brazing. After brazing, remove excess brazing metal from the face of the work. Make a sample joint for the architect's approval before proceeding with the work of joining.

Welded joints

Welding of Copper shall be done by the inert-gas tungsten-arc process, using a suitable welding rod such as Anaconda Copper-372, conforming to ASTM Specification B259, Classification RCu, for color match. (Since the copper is tough-pitch type, welding, even with inert-gas-arc processes, should be done only if the metal is not to be formed or worked after welding because the joints are apt to lack sufficient ductility.)

Where welding is required in the joints of Extruded Architectural Bronze or in sheets of Muntz Metal (No. 16 B&S gage or heavier), the oxyacetylene method is the most suitable. It is preferred to arc welding because the high zinc content of these alloys produces excessive fuming. To insure good color match at the exposed joints, pieces of the base metal or Anaconda-997 (Low Fuming) Bronze, conforming to ASTM Specification B259, Classification RCuZn-C, shall be used as filler material. Adjusting for an oxidizing flame will minimize the porosity of the joints in Architectural Bronze which is ordinarily caused by the lead in the alloy.

The welding of Yellow Brass shall be done with an oxyacetylene torch using a low-fuming bronze welding rod, such as Anaconda-997 (Low Fuming) Bronze, conforming to ASTM Specification B259, Classification RCuZn-C.

Exposed joints in Nickel Silver shall be welded by the oxyacetylene process, with an oxidizing flame, using a piece of the parent metal or Anaconda Nickel Silver-828, conforming to ASTM Specification B259, Classification RBCuZn-D, as filler material.

Everdur shall be welded by the oxyacetylene, carbon-arc, or the inert-gas tungsten-arc method of welding, using a copper-silicon welding rod, such as Everdur-1010, conforming to ASTM Specification B259, Classification RCuSi-A.

COLOR AND SURFACE TREATMENT

Metal finish

All of the architectural metals shall be given a "satin finish" unless otherwise specified. This finish shall compare to US 10-Dull Bronze, of the Federal Specification FF-H-106a on Builders' Hardware; Locks and Door Trim. The finish may be obtained by means of sanding belts using No. 80 grit, 120 grit and 240 grit, a canvas buffing wheel with abrasive, a Tampico brush, cloth buffing wheel with compound, or rubbing by hand with fine-abrasive emery cloths.

COPPER

All exterior architectural copper work shall be washed with soap and hot water, trisodium phosphate, or sodium metasilicate (4 to 8 ounces to a gallon of water) to remove all traces of oil, grease and other foreign matter. This shall be followed by a plain water rinse using a bristle brush, and then wiping the metal dry. Stains from soldering flux or other causes shall be removed by gentle rubbing with fine steel wool. Caution: The workmen shall wear cotton gloves so that the Copper will remain clean and weather evenly.

To produce a dark bronze finish, the work shall then be wiped with boiled linseed oil and rubbed dry.

For an artificial blue-green patina, the copper shall be cleaned as above, but, in addition, if it has become oxidized it shall be swabbed with a cloth dipped in a 5% to 10% solution of sulfuric acid. This shall be followed by a thorough rinsing with clean water. *Warning:* Always pour concentrated sulfuric acid into cold water, never the reverse. Wear rubber gloves, goggles, and suitable clothing.

After new copper has been exposed to at least two rains it shall be sprayed with an application of ammonium sulfate of the following proportions, measured for 1000 square feet: Ammonium sulfate 6 pounds, copper sulfate 3 ounces, concentrated ammonia 1½ fluid ounces, water 6½ gallons. About three applications with drying in between are usually required. The patina should develop overnight. Subsequent spraying with water may be advantageous.

ALTERNATE: When the copper is bright and clean, it shall be given a spray application of saturated commercial ammonium chloride. The solution shall be allowed to stand 24 hours before being used. A second application shall be made in 48 hours. The following day, the entire surface shall be sprinkled or sprayed with a mist of clean water.

RED BRASS

Bright finish

The natural color of the bright metal and the finish shall be preserved by an application of lemon oil, suitable wax or a spray coating of best-quality outdoor lacquer, as directed by the architect. The lemon oil may be commercial grade; the wax, carnauba or approved equal; and the lacquer may be DuPont's "Methacrylate" No. 1234, Pyroxaline Lacquer Company's "Pyroxcote", or G. J. Nicholas Company's "Porceleen" or equal. The metal shall be thoroughly cleaned and uniform in color before any protective coating is applied.

Antique or dark finish

The Red Brass shall be chemically treated to produce a statuary bronze coloring. This shall be done by brushing on several applications of a mixture of potassium sulfides (liver of sulfur), such as McKeon's Liquid Sulfur, 1 ounce per gallon of water. This solution shall be applied to the surface of the metal with a bristle brush until the coloring of the metal is darker than intended. The finish is then relieved and brightened to the desired shade by gentle rubbing with fine steel wool or with powdered pumice and water. After the work has been wiped clean, it shall be given a coating of lemon oil with a cloth, followed by vigorous rubbing, thus leaving a film that is hard and dry.

ARCHITECTURAL BRONZE AND MUNTZ METAL

Bright finish

The work shall be cleaned to the bare bright metal with a concentrated solution of oxalic acid and fine abrasives such as pumice and water or No. 00 steel wool. Once the metal is cleaned, it shall be handled only with cotton gloves until protected with a coating of oil, wax, or a spray coating of best-quality outdoor lacquer, as specified.

Antique or dark finish

These metals shall be cleaned with soap and water, or with a suitable metal cleaner if necessary, to remove all traces of grease or oil and other foreign matter. This shall be followed by a brush application of a solution containing 5% cupric chloride plus 5% hydrochloric acid. The purpose is to produce a film of copper on the surface for better results in coloring.

The metals are now ready for several successive applications of a mixture of potassium sulfides (liver of sulfur) or McKeon's Liquid Sulfur, 1 ounce per gallon of water, applied to the surface of the metal with a bristle brush. This should produce a very dark coloring which can be brought back to a dark, medium or light Statuary Bronze finish as desired by gentle rubbing with pumice and water or with No. 00 steel wool. Heat from an open flame or furnace will darken the finish. Another method which gives a dark finish consists of one or two applications of a 10% solution of antimony trichloride directly to the metal, rubbing the finish with steel wool to obtain the desired depth of color and luster. Submit sample for architect's approval.

The work shall then be given a coating of lemon oil or wax rubbed on hard and wiped dry, leaving only a thin protective film to prevent abrasion and to facilitate future cleaning and wiping.

YELLOW BRASS

Yellow Brass shall be cleaned of oil, grease or other foreign matter with mineral spirits, or soap and water. It shall then be brightened by rubbing with fine steel wool, or with Aloxite or jewelers' abrasive cloth. The work, when clean and free of finger marks, shall be given a spray coating of best-quality indoor or outdoor lacquer, as required, subject to the approval of the architect.

NICKEL SILVER

All Nickel Silver shall be thoroughly cleaned to the bright metal with detergents and fine abrasives. For work on the exterior, apply a spray coating of DuPont's "Methacrylate" No. 1234, Pyroxaline Lacquer Company's "Pyroxcote", G. J. Nicholas Company's "Porceleen" or equal, after the metal is clean and dry. Interior Nickel Silver shall be waxed or lacquered as directed by the architect.

EVERDUR

Everdur (copper-silicon alloy) shall be cleaned with detergents to remove grease and oil or other organic matter. The surfaces shall then be rubbed, in the lengthwise direction of the finish, with No. 00 steel wool until the bright new color of the Everdur is uniform throughout. The metal shall be given a hand-rubbed protective film of oil or wax.

PROTECTION OF FINISHED METALS

Finished metals that are ready for delivery must be protected from all harm, including damage from handling, both in transit and on the job, as well as soiling, staining and mishaps of any kind. The surface of the metal is to be protected by wrapping with waterproof paper or tape. A sprayed, strippable plastic coating may be used if the schedule will permit removal of the coating within sixty days in summer weather.

When the protecting materials are removed, the metals shall be cleaned with a suitable cleaning agent and shall be given a new coating of oil or wax as specified.

OTHER ANACONDA PUBLICATIONS
for Architects, Designers and Mechanical Engineers

Recognizing the help that handy, factual information about Copper and Copper Alloy Building Products can be to architects and others responsible for the selection of materials, The American Brass Company offers the publications listed below, without charge. Please address your request for copies to Architectural Service, The American Brass Company, Waterbury 20, Connecticut.

GENERAL PLUMBING AND HEATING

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B-1SA **Anaconda Copper Tube and Fittings**
Anaconda Pipe—Copper and 85 Red Brass

Information on Anaconda Brass and Copper Pipe, Copper Tube and Fittings. Includes Size and Weight Tables for Standard Pipe and Copper Tubes.

C-33 **Anaconda Copper Tube and Fittings for Sanitary Drainage Systems**

Outlines the advantages of Anaconda Copper Tube for soil, waste and vent services. Illustrates the wide range of Anaconda cast-brass solder-joint fittings available.

C-6 **Radiant Panel Heating with Anaconda Pre-formed Copper Tube Panel Grids**

The full story of Anaconda's Copper Tube Panel Grids (PG's). A machine-formed grid, PG's provide the most economical Copper Tube radiant panel heating installation. Publication contains complete information on the use of PG's from engineering and layout design to finished installation. This Anaconda publication has been awarded Certificate of Merit by the Producers' Council, Inc., and the National Assoication of Home Builders.

C-12 **Anaconda Copper Tube Fittings and Valves**

A catalog listing of Anaconda solder-joint fittings and valves including roughing-in measurements and suggestions for installation. Gives detailed information on all types of wrought-copper and cast-brass fittings and cast-brass valves.

ROOFING AND SHEET METAL WORK

ANACONDA
PUBLICATION NO.

C-1 **Modern Sheet Copper Practices**

Contains detailed drawings, descriptions and suggested specifications on the uses and installation of sheet copper in building construction. This 112-page book received a Certificate of Exceptional Merit by The American Institute of Architects and The Producers' Council.

C-3SA **Anaconda Sheet Copper for Building Construction**

An informative booklet describing the uses of Anaconda Copper in building construction—10 oz. Economy Copper Roofing, Anaconda Through-Wall Flashing and "Electro-Sheet" Copper. Detail drawings of copper gutters, flashing, copings, spires and expansion joints.

C-28 **Anaconda Through-Wall Flashing**

Explains the necessity for flashing and the design advantages of Anaconda Through-Wall Flashing. Illustrates standard and special flashings available and provides detail drawings of copings and parapet flashing.

ARCHITECTURAL

B-7T **Extruded Bronze Thresholds**

Illustrates the types and sizes of the wide range of Anaconda standard architectural bronze thresholds.

B-37 **Anaconda Standard Extruded and Drawn Architectural Shapes**

An itemized listing of the sizes of angles, channels, tees, zees, rods, and tubes commonly used in architectural designs. Includes information as to the alloys in which the various shapes can be furnished.

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Notice

The statements and data contained in this publication are based on extensive investigation and practical experience, and represent the best information available at time of printing, January, 1959. This information is subject to change at any time, principally because of new developments and changes in practice. Since the Company does not control or supervise subsequent installation of its products, it cannot assume responsibility for performance in service.

01.1701. Eleanor Pepper

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